Established 1916 as
THE OIL WEEKLY

OCTOBER, 1955

WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING,
PRODUCING OPERATIONS AND MANAGEMENT

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PK

DRILLING PROGRESS ISSUE

Is research keeping pace with the industry?

By A. W. Thompson

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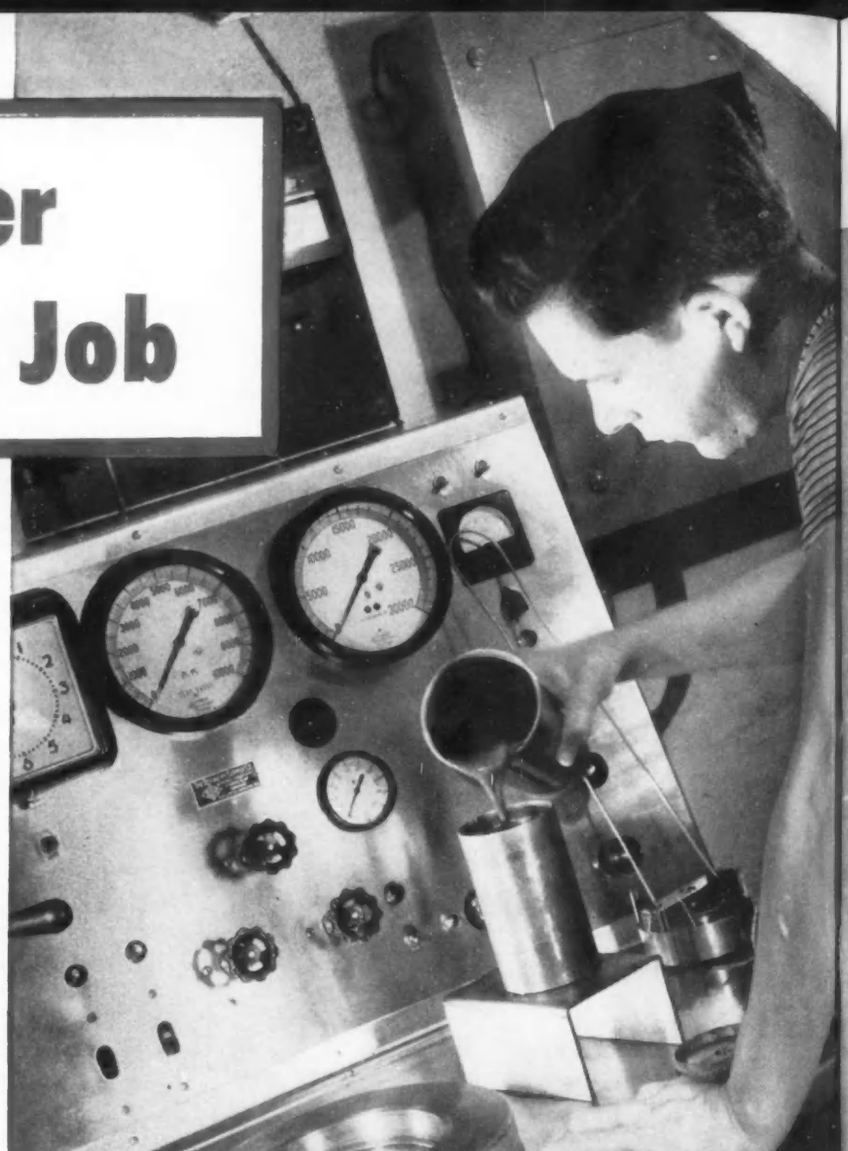

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Select Cement to Fit the Job!

Vol. 141, No. 5

October, 1955

WORLD OIL

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CURRENT OUTLOOK SECTION

Looking Ahead ... 79
Editor's Page ... Warren L. Baker 81
Is Drilling Research Keeping Pace With Other Industry Advancements? ... A. W. Thompson 82
Four Steps to the Sea ... 86
Is Your Insurance Covering? ... 87
This Man Is Dangerous? ... 90
Foreman Training Courses Reduce Costs and Accidents ... Gene Graham 94
Mr. Gus Moves ... 100
Salt Dome Offshore Drilling Structure Features Portability ... 104
Changing Panorama: Why Idleness Compensation Plans Are Unnecessary in Oil Industry ... 106
Petroleum Trends in the U. S. ... Cecil W. Smith 110
Report from Observatory ... Ray L. Dudley and Warren L. Baker 112
The Month's Completions ... 114

EXPLORATION SECTION

Why Geologists Should Know About Mud in Rotary Drilling ... Dr. George R. Gray 117
Exploration Men Must Work Hard and Well to Find Needed Oil ... Harold T. Morley 121
Lower Wolfcamp Important Pay in New Mexico ... S. G. Hardison 128
Wildcatting at Fast Pace ... Cecil W. Smith 134

DRILLING SECTION

Mud Rate and Weight Logging Promises Gas Sand Evaluation ... Jack R. Fraser 137
Unit Keying—A Way to Cut Rigging Costs ... Staff Article 144
Hydraulic Torque Converter in the Mud Pump Drive ... M. H. Woodward 152
What's Happening to Turbodrill Development? ... W. R. Postlewaite 156
How to Light a Rig ... H. L. Logan 161
'Packaged' Rigs Will Cut Moving, Rigging-up Costs ... J. E. Armstrong 165
How to Prevent Blowouts ... T. Gaines 173
Increase Pump HP on Existing Rigs by Adding Engines to Drive Group ... R. W. Craig 178
Tubing Versus Drill Pipe in Slim Hole Drilling ... D. M. Best 182
Watch Your Minutes! ... J. Pat Kidd 191
How to Do It—Drilling Hints ... 196

PRODUCTION SECTION

Drilling and Producing High Drift Angle Directional Wells ... Daniel S. Johnston and James T. Carriel 209
Safety Factors Involved in Drill Stem Testing ... Roy L. Bulls 216
Texas' Biggest Fracturing Job ... Anthony Gibbon 218
Problems of Two-Zone Pumping and How They're Being Solved ... Bob Erskine 222
Recovery Increase by Thermal Drive ... J. Van Heiningen and N. Schwarz 230
Modern Well Completion Methods: U.S.A. ... A. S. Soliday 238
How to Do It—Production Hints ... 256

INTERNATIONAL SECTION

TexPet's Unique Rig for Amazon Operation ... Anthony Gibbon 265
A Camp City Profile: Kirkuk ... 268
Venezuelans Are Learning About the Oil Industry ... William A Jansen 270
What's Happening Among World Oil Men ... 295

DEPARTMENTS

Who's Meeting Where ... 76
What's Happening Among Men in the Industry ... 306
What's Happening Among Industry Associations ... 322
Companies in the News ... 328
What's Happening Among Service and Supply Men ... 330
Trading Post ... 347
Classified Advertising Page ... 347
Squeaks from the Bullwheel ... 348
New Books, Maps and Movies ... 354

NEW EQUIPMENT SECTION

What's New in Equipment ... 356
New Equipment Catalogs and Literature ... 362

ADVERTISERS' INDEX ... 366

a quick look at WORLD OIL THIS MONTH

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

CURRENT OUTLOOK

☐ **Is drilling research keeping pace** with other oil industry advancements. An outstanding leader in the drilling contracting field expresses some doubts and comes up with some statistics that may surprise some. It is pointed out that unless immediate attention is given to this problem within the contracting field, the industry as a whole will suffer. Turn to Page 82. **Is Drilling Research Keeping Pace With Other Industry Advancements?** ... **A. W. Thompson.**

Turn the Page ➧

THIS MONTH . . .

☐ **Four types of rigs stand as mechanical monuments** to the ingenuity of the men in the drilling industry. From the standard cable tool rig of the early days of the petroleum industry to the giant offshore units of today, each type is a symbol of an era. **Four Steps to the Sea**.....Page 86

☐ **Is your insurance program up-to-date?** These are fast-changing times. Keep abreast with your workmen's compensation and general liability plans. **Is Your Insurance Covering?**.....Page 87

☐ **The most dangerous object in the drilling industry** is the new man on any rig. Here's how Southeastern Drilling Company of Dallas is attempting to make him less hazardous, and here, too, are the results of one of the most successful personnel programs in the industry. **This Man Is Dangerous!**.....Page 90

☐ **Toolpushers are timeclocks of the accounting division** in a contract drilling company. So it follows that if a drilling forman is given formal training in company paperwork, both in the field and in the main office, he can be an important factor in reducing costs. This was the reasoning of Thomas P. Pike Drilling Company. A training course has verified it. Moreover, the accident frequency has been reduced. See Page 94. **Foreman Training Courses Reduce Costs and Accidents**.....Gene Graham

☐ **The giant offshore drilling platforms** have been engineered to withstand the onslaught of the seas. But on moves, the fate of this multi-million mammoth is in the hands of tiny-by-comparison tugboats. For a description of such a move, read . . . **Mr. Gus Moves**.....Page 100

☐ **A new offshore structure** has been built for Salt Dome Production Company. The all welded prefabricated derrick and engine structure is designed so that it can be handled in four lifts. **Salt Dome Offshore Drilling Structure Features Portability**.....Page 104

☐ **A guaranteed annual wage** has been much in the news recently. But there is no serious need in the oil industry for supplemental unemployment compensation plans such as those adopted by the automobile industry. Steady jobs prevail in all divisions of the petroleum industry. Continuous employment has been achieved through efficient and steady operation. There are several important reasons why oil workers in general have not suffered from short work weeks and layoffs. For these reasons and a discussion of other significant phases of this timely topic, see **The Changing Panorama**.....Page 106

EXPLORATION ARTICLES

☐ **The drilling fluid is of great importance** to the petroleum geologist. It is the means through which he gains information about conditions in the well bore, according to the author of an article beginning on Page 117. **Why Geologists Should Know About Mud in Rotary Drilling**.....Dr. George R. Gray

☐ **Geologists are facing another challenge.** Never before has the oil industry been so dependent on the earth sciences. In the past, the geologist has measured up to the demands made upon him. Today, with oil finding becoming more difficult and expensive, the geologist faces a still greater challenge. How he can meet this challenge, is described in the article beginning on Page 121. **Exploration Men Must Work Hard and Well to Find Needed Oil**.....Harold T. Morley

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Warren L. Baker, Editorial Director
WORLD OIL
P. O. Box 2608
Houston, Texas

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Looking Ahead . . .

. . . **U. S. imports will be cut** immediately and sufficiently to bring them to their 1954 ratio with U. S. domestic production of crude oil. H. J. (Jack) Porter, Texas Republican national chairman, who has been working quietly but steadily on the matter for more than a year, believes it is merely a matter of Defense Mobilizer Fleming working out the mechanics of how to administer curtailed quotas.

. . . **Prosperity prevails in Europe as well as U. S. and Canada.** But booms in England and on Continent are becoming unhealthy as inflation develops. Britain's imports outrun exports, and government is expected to apply deflationary brakes. Britain's economic difficulties usually slop over onto Continent. European imports from U. S. may henceforth decrease.

. . . **U. S. boom so far continues unabated.** But in U. S., as abroad, inflationary pressures increase, shortages develop, and prices creep upward. Government already has applied brakes slightly by raising interest rates, but may further tighten money supply to control inflation. Like other booms, this one raises the threat of going too far and ending in a letdown.

. . . **Agitation for higher crude prices has begun** and likely will swell, as increased costs of labor and materials are hurting producers. Oil Producers' Agency of California has indicated need for revising California crude prices, unchanged since February, 1953. R. R. Von Hagen, president of the agency, listed increases meanwhile in producers' costs as follows: casing and tubing 18.2%, sucker rods 20.8%, tankage 11%, pumps 23%, production service 7%, and gun perforating, bit costs, and trucking 10%. Payroll costs per barrel of oil produced have increased 18.6%, he added. Improved economic factors in the industry, including greater demand and lower stocks, would support higher crude prices, he indicated.

. . . **Not until 1956 will there be an easing of the present increasingly tight supply of steel** and some other metals. Coming months will bring delays in delivery of metal products and may bring some paying of premium prices. All forms of steel are scarce.

. . . **Demand for residual fuel oil, already strong, will be further stimulated by higher coal prices.** Bituminous coal prices were increased in early September at both northern and southern mines, by 25 to 40 cents a ton. Price hikes followed a new labor agreement with miners' union.

. . . **Reduction of corporation income taxes in 1956 seems doubtful,** although cuts in personal taxes are quite likely.

. . . **Oil tankers are in strong demand and will continue so indefinitely** because of sharply expanding world use of petroleum. Tankers under construction and on order were declining for the past two years, but have turned upward in recent weeks, and active world-scope tanker building lies ahead. Most of the construction will occur abroad, as U. S. will build few tankers, due to high costs.

. . . **Drilling in California offshore wildcat areas probably will not commence until next spring,** even though California State Lands Commission was authorized by new legislation to accept bids for offshore parcels on September 7, 1955. Six months will be needed to process bids and hold public hearings that may be involved. Commission can grant a lease to the high bidder, whether he plans to drill with platforms, barges or filled land islands; requiring only that such structure be safe and comply with all marine regulations.

. . . **Probable effects of increasing automation will be studied** in three weeks of congressional hearings beginning October 10. Under leadership of Rep. Wright Patman (D.-Tex.), a House subcommittee will try to foresee if automation will make big companies bigger and squeeze small ones out of business; if government should plan retraining programs; if intensified worker placement programs will be needed. Automation is extensive and increasing in oil and gas industries.

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Future to Require Increased Drilling

The remarkable growth of the drilling contract business in the U. S. during the last 10 years is to continue in coming years. The future will see U. S. contractors drilling far more wells and footage than ever before. This will be necessary to provide sufficient producing ability to satisfy enlarged future consumption.

This bright prospect is based on indications that there will be no interruption in the miraculous growth in oil consumption. Population is to grow faster than ever before. Per capita consumption is rising throughout the world, as many countries become more heavily industrialized and mechanized. Many new uses for oil and gas are being developed constantly.

The world is using twice as much oil today as 10 years ago, but is likely to again double its consuming rates during the next 20 years. By 1975 world demand probably will reach 29 to 30 million barrels per day. Current world consumption is 15½ million barrels daily, in contrast with only 7⅔ million barrels in 1945.

Much of the future growth will be outside of the U. S. Demand abroad has more than doubled in the past 10 years. It seems probable that demand outside of the U. S. will climb to 15 or 16 million barrels daily by 1975, compared with 7¼ million barrels in 1955.

U. S. consumption also is expected to show big future growth. U. S. demand is likely to reach 14 million barrels daily by 1975, nearly 6 million barrels greater than the 8¼ million barrels which will be consumed during 1955. Current U. S. consumption is double that of 1943, and two-thirds larger than in 1945.

•

Greater quantities of oil will need to be produced in coming years to satisfy increased future consumption. Twenty years from now nearly twice as much oil will need to be produced.

While an increasing portion of the world's production will come from abroad, the anticipated tremendous surge in consumption also will give the U. S. an opportunity to expand its production in the years ahead. It is significant to realize that U. S. consumption by 1975 will be of sufficient magnitude to permit the importation of twice as much foreign oil and still necessitate domestic production of 4 million more barrels per day than at present. If this is the pattern by 1975, it means that U. S. production must be increased 60 percent.

•

Far higher U. S. drilling rates will be necessary to make enough oil available to satisfy the nation's enlarged future consumption.

U. S. drilling rates have undergone sharp growth during the past six years. Approximately 55,000 wells are expected to be drilled this year, 12,000 more than in 1950 and nearly 16,000 above 1948. Footage drilled has increased even more rapidly, rising to an estimated 225 million feet in 1955, which is 75 percent more than the 136 million feet drilled in 1948.

However, enlarged future producing needs will require the drilling of an even larger volume of wells and footage than present peaks. The day will come when the U. S. will be drilling 65,000 wells and 275 million feet of hole, and even more.

•

Keen competition will continue to exist in the contracting business, despite bright prospects for additional drilling growth. Labor, equipment and service costs are apt to be higher tomorrow, while rivalry for contracts will keep revenue down.

Consequently, contractors must still continue to seek ways of obtaining faster penetration rates, less troublesome holes, and means of reducing time spent in non-penetrating operations. Only those who succeed in keeping pace with their most progressive competitors will be in business to share in the future's increased drilling volumes.

Warren L. Baker

Is Drilling Research Keeping Pace With Other Industry Advancements?

Here's an answer that says no . . . and cautions that unless the drilling contractors, representing a billion-dollar industry, accelerate their research efforts, the petroleum industry as a whole will suffer.

By A. W. THOMPSON, A. W. Thompson, Inc., Houston

ONE OF THE MOST neglected phases, yet one of basic importance to drilling operations, is research—research planned on the basis of sound financing, supervised coordination, reasonable facilities, trained personnel. Program objectives cannot be haphazard. Goals must be set and the established route closely followed.

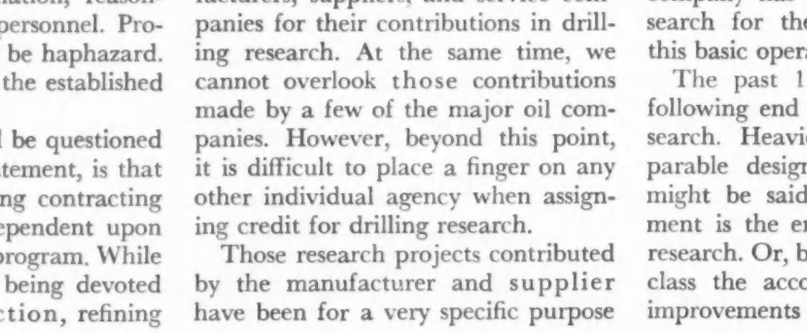
A statement that will be questioned by many, yet a true statement, is that the future of the drilling contracting field will be heavily dependent upon an intensified research program. While millions of dollars are being devoted to exploration, production, refining and marketing research, only pennies are being plowed into drilling research. Yet, the very basic fundamental of petroleum production is the efficient, rapid completion of a well bore.

This is not a new subject! The contractor with foresight, the contractor who shuns just day to day planning and looks to the future when thinking in terms of our position in the industry, has recognized the need for intensified drilling research for many years. Yet, the net result of this trend of thought is barely discernable.

A tribute must be paid the manufacturers, suppliers, and service companies for their contributions in drilling research. At the same time, we cannot overlook those contributions made by a few of the major oil companies. However, beyond this point, it is difficult to place a finger on any other individual agency when assigning credit for drilling research.

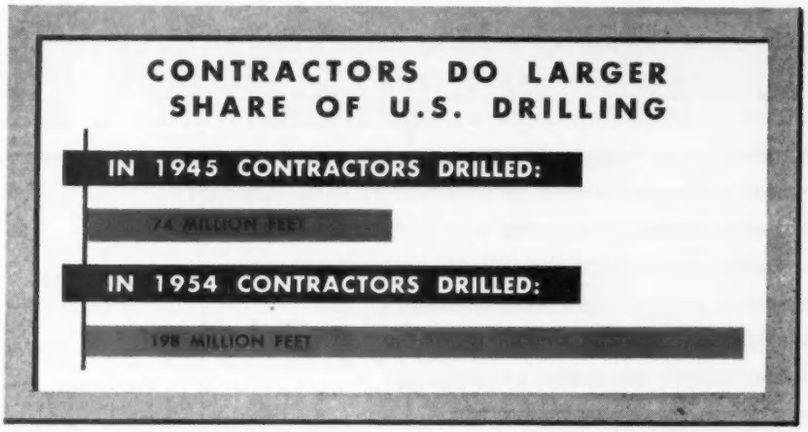
Those research projects contributed by the manufacturer and supplier have been for a very specific purpose —to increase production efficiency, profit and to allow the company to remain in a top level position competitive-wise. Likewise, the major oil company has invested in drilling research for the purpose of bettering this basic operation.

The past 15 years have seen the following end products of drilling research. Heavier machinery of comparable design at higher costs! It might be said that this accomplishment is the end product of negative research. Or, better yet, we can merely class the accomplishments as minor improvements coming from an unscientific trial and error method.


DRILLING CONTRACTORS LAX IN RESEARCH INVESTMENT
GROSS INCOME 1945 TO 1954
7 BILLION
RESEARCH INVESTMENTS 1945 TO 1954 ONLY $55,000

The Contractor's Role. Contractors cannot sit back smug and happy and throw drilling research upon the shoulders of some other part of the oil industry.

The drilling contractor field has become so highly competitive that danger is seen on the horizon. Every limit of equipment and personnel performance is being stretched to the utmost in trying


CONTRACTORS DO LARGER SHARE OF U.S. DRILLING
IN 1945 CONTRACTORS DRILLED:
74 MILLION FEET
IN 1954 CONTRACTORS DRILLED:
198 MILLION FEET

"Contractors cannot sit back smug and happy . . . and throw drilling research upon the shoulders of some other part of oil industry."

to do a decent job at a decent profit. In fact, the day is arriving rapidly when it can be said that we are getting the near maximum efficiency out of equipment presently available.

We must not overlook the point that the manufacturer rapidly is reaching a situation wherein further research must be closely gaged and governed. For example, the steel mills cannot be expected to exercise an all-out effort in drill pipe research, a condition substantiated by the fact that the past ten years has seen no major change in drill pipe metallurgy. It must be remembered that tubular goods are a minimum output product of the average large steel mill and they cannot possibly afford to invest heavily in concentrated research.

At the same time, machinery manufacturers, facing increased expenses in fabricating materials, are forced to carefully budget for research when research is considered in order.

From this point, one can carefully inspect the entire field of the manufacturer, supplier, and service company, and readily recognize that they are in no position to promote long range research programs of the caliber needed by the drilling industry.

Contractors must do the job whether they are willing to admit it or not. The industry has assigned the contractors one of the heaviest responsibilities in the picture of oil production—the assignment to drill over 92 percent of all wells during 1955. To continue to maintain this position within the industry, contractors must act.

If we are honest in our evaluation of the present day drilling contractor business, we must admit the following:

- Every last limit is being stretched to squeeze maximum efficiency out of equipment which, except for size, weight, and cost, is the same machinery we used two decades ago.
- The highly competitive aspect of the drilling contracting field forces contractors to recognize that they must call upon their own resources and tackle the problem cooperatively.
- The drilling contracting business—possibly one of the most unique in the industrial world—has been built by strong individuals and now exists upon the strength of the individual contractor.

Continuing drilling research at a more accelerated pace must not be overlooked if for the sake of just pride in the business with which we are associated.

The great expense of offshore drilling has forced the average contractor out of the picture. The drilling of marginal wells is shelved until the operator has no other choice because of lease commitments or other stipulations, due to high drilling costs. Then, if contractors can lower drilling costs through intensified research, the overall drilling program will undoubtedly increase and greater petroleum reserves will be uncovered.

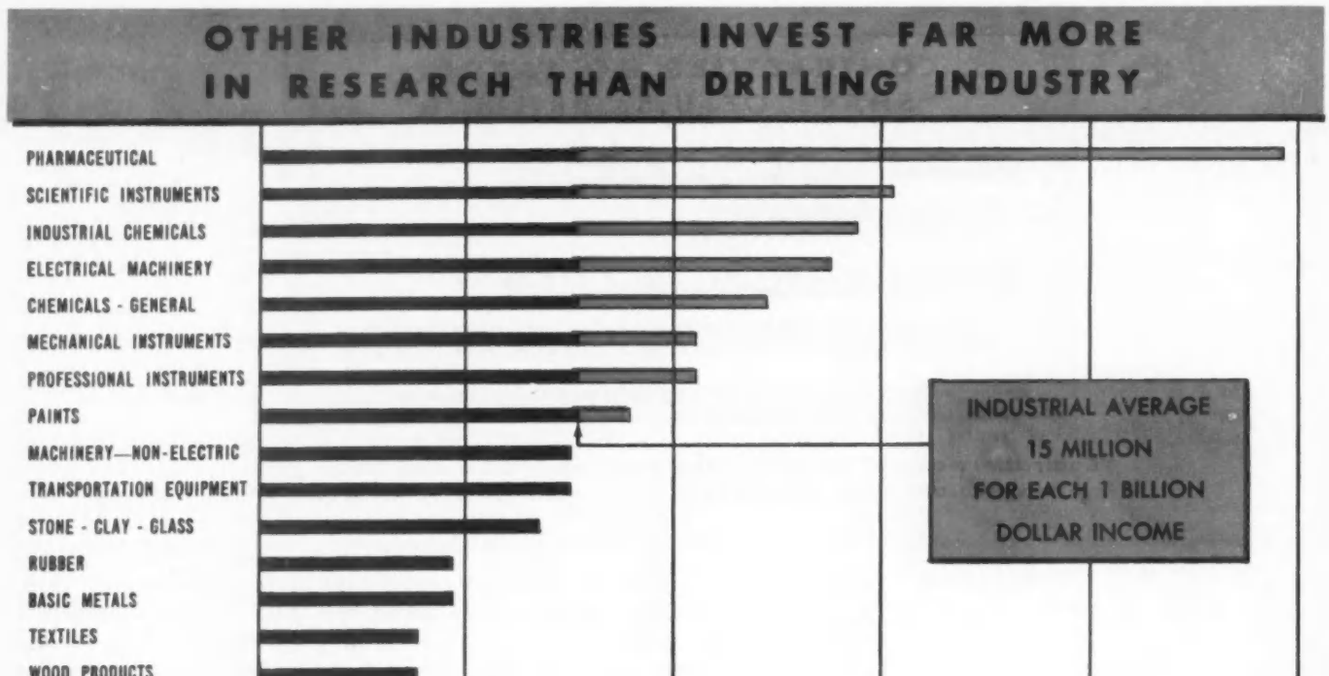
What Have We Done? During the past ten years, the American Association of Oilwell Drilling Contractors has invested in just two research projects. The 1945 investigation of drill pipe and the 1954 drilling fluid study. Approximately $55,000 was spent on these two projects.

During the same period, the drilling contractors grossed about $7 billion. And, from 1945 through 1954, about 6800 new rigs were purchased by drilling contractors. Then, for the sake of comparison, it can be said that the drilling contracting industry has, during the past ten years, invested 8/10,000 of 1 percent of gross income in drilling research. Or, on the basis of the billion dollar rig purchasing program seen during the past 10 years, we have invested just $1.23 in research for each new rig purchased.

For a billion dollar industry, contractors cannot look upon this record with any particular pride. Yes, we have invested cooperatively with other agencies in research ventures, but even an evaluation of this very limited participation quickly spells the fact that we have not done nearly enough to promote and extend the operational efficiencies needed by our industry.

Increased Penetration Rates? Penetration rates have been increased with profit to both contractors and customers, but has the accomplishment of this end followed a scientific route? No, of course it hasn't. In short, it can be summarized that those factors contributing to increased penetration rates have not come from applied research but from hit and miss or trial and error techniques.

Years have been spent in the matter of finding the jet bit and learning that greater weights can be carried on the bit simply because the problem has been approached from many directions, but with little or no coordination. Accidentally some information developed by one operator was spliced to another remnant of data discovered by another operator. In this manner, the picture finally was completed. This



is certainly not a very scientific approach to problem solving. The process has been time consuming and expensive.

We do have the jet and chert bits, oil-emulsion mud, and we are more familiar with the practice of running drill collars to place greater weights on the bit; however, in each case much is lacking insofar as a true understanding of the most efficient use of each tool.

What Are Others Doing? In comparison to other industries, the drilling contractors have lagged far behind in this business of supporting research. While pharmaceutical houses invest nearly 49 million research dollars per billion-dollar income; while the food processor spends nearly 3 million research dollars per billion-dollar incoming revenue; the drilling contractor has spent just 78 hundred research dollars per billion-dollar income during the past 10 years.

Another example of what associations can do research-wise is seen in a project recently completed by The Asphalt Institute, a non-profit association sponsored by members of that industry to serve both users and producers through program of engineering, research and education. By accessing members on a tonnage output basis, this organization gathered sufficient funds to complete a well staffed research laboratory on the University of Maryland campus. Former Congressman Jennings Randolph, present at the inaugural ceremonies, declared, "Tomorrow's highways are being built in the laboratories of today." Oddly enough, this very same philosophy can be injected into our thinking by effect that tomorrow's wells are being drilled in the laboratories of today!

Industry's interest in basic research doubtless has been spurred by the knowledge that some of the most profitable new products in the field of medicine, textiles and electronics have been unexpected by-products of basic research.

A transition is seen in this trend of thinking. Private industry is fast taking over in the field once the all but exclusive property of colleges and governmental agencies—the field of industrial research. As colleges and governmental agencies trim their budgets for basic research, private industry is increasing the amount of money it puts into this type work. An exception to the cause is the drilling contracting industry.

Then, by entering the field of industrial research, the drilling contractors are not by any means pioneering. The pace has already been set by other fields of the petroleum business and a vast majority of all other outside industries.

What Would Come of Research? The inauguration of a jointly sponsored research program under the auspices of the AAODC will at least be a step in the direction of accomplishing the following desperately needed improvements:

- Improved alloy steels.
- Lighter weight equipment that could withstand increased torque and stress.
- More and better automatic controls and recording devices.
- A better understanding of all drilling techniques.

- Crooked hole causes and solutions.

Any one of the above fields will provide a lucrative subject for research. For example, do we know what a crooked hole really is? Do we know exactly what causes a crooked hole? Of course we don't, if we are completely honest in an inventory of our true knowledge. In this field alone, a majority of the contributions have come from just two individuals within the industry, and neither is connected with a drilling contractor firm.

We have progressed, yes. The past ten years have seen the gradual transition from steam to power rigs; but, beyond that, there are few significant contributions that can be recorded.

Drilling reseach can be applied, for example, toward the development of surface recording devices which indicate continuous hole deviation, drilling hydraulics and other pertinent data, of great importance to the contractor. The field of automatic drilling controls has been barely touched, and a study of drilling technique is surely in order.

A Pool of Technical Personnel Is Essential. We must face the fact that well seasoned technical personnel will not filter into the drilling field for quite some time. At the moment, the major operator faces a critical problem in the matter of recruiting technical personnel, and the drilling contractor, competing for technical personnel, does not stand much of a chance in the long run. Although the drilling contractor desperately needs the assistance of technical personnel, individually we can hardly afford to employ engineers of sufficient experience to make immediate contributions.

By the same token, it is difficult to attract a young engineer to the drilling field with the idea of working him through the organization to a position of responsibility. This angle we must forget for the moment. Aside from the highly competitive bids for young engineers, the average engineer will seek employment with the major producing company where a well beaten path shows him the way to the top.

In lieu of our lack of engineering personnel, and with the problem facing the equipment manufacturer in the same matter, we must pool our resources to establish an engineering research program designed specifically for the drilling contractor group.

Where Will the Money Come From? Facilities essential to inaugurate drilling research will possibly involve an expenditure of $500,000 for the first year. The fund must be contributed by members of the AAODC and program coordination will be afforded by selected members of the same organization.

Funds for a research program can logically be assessed on the basis of footage drilled. The year 1955 will likely see the completion of over 200 million feet of contract hole. Then with the investment of just ¼ of 1 cent per foot of hole drilled, funds for the program can be gathered.

I will venture to say that the sacrifice of this sum from the contractor's net profit will not force the competent operator upon the brink of bankruptcy. Furthermore, the progressive drilling contractor will be interested in making such a long range investment on the basis of those benefits which will undoubtedly come from properly supervised research.

The expenditure of millions of dollars in exploration, production, refining, and marketing research is certainly an expression of confidence in the petroleum industry. By the same token, the drilling contractors' laxity in an interest toward cooperative drilling research is not indicative of a sincere interest in the industry as a whole. It is somewhat of an expression of disinterest toward nurturing, expanding, and guaranteeing a long profitable life for the field of oil well drilling contracting.

The burden of improving drilling operations rightfully becomes the responsibility of those engaged in the business. This means the drilling contractor. —**The End**

Small rig is using percussion-type tool on first hole drilled. Rotary table is turned in conventional manner but with percussion action also taking place in tool at bottom of string. Generator and control panel units, for percussion tool control, are mounted on trailer.

Percussion Drilling Tool Field Tested

EXPERIMENTAL DRILLING operations in test holes in the Simi Valley area in California have proven the ability of a rotary-percussion type drilling tool to drill through diorite granite at rates as high as 30 feet per hour using a 14¾-inch cone type bit. Penetration was reduced to 3 feet per hour when drilling with straight, or conventional, rotary action. A marked characteristic of the percussion tool was noted in its ability to maintain near-maximum penetration with tool string loads as low as 2500 pounds, a factor which greatly extends bit and drill pipe life. Also, much straighter holes have resulted from the decreased loading on the bit.

No changes in present rotary equipment is required except for the addition of an engine-driven alternator, control console, electrical slip ring distributor and transmission cable, the latter being installed through the axis of the drill pipe. Easily installed using spiders which center the cable in each joint, company engineers say that 10,000 feet of cable can be installed in eight hours.

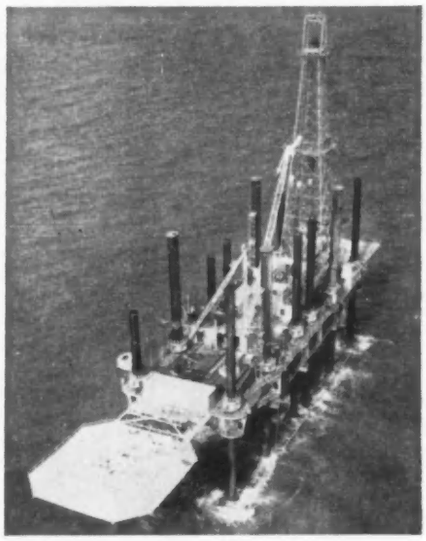
Accompanying photograph shows the first tool, 12¾ inches in diameter, with a 14¾-inch cone type bit. A 9-inch tool, production of which presently is under way, is designed to afford an impact force of 30,000 pounds at 1800 strokes per minute.

It is claimed that the new rotary-percussion tool is capable of drilling either with mud or air circulation. The tool was designed to afford improved penetration in extremely hard formations but experience has indicated that marked improvement also has been noted when drilling in soft shales. —**The End**

1. Standard cable tool rig.

2. Conventional steel rotary.

3. Portable rig.



4. Offshore rig.

Four Steps to the Sea

These four types of rigs stand as mechanical monuments to the ingenuity of the drilling industry.

SHOWN HERE are four oil well drilling rigs, each the symbol of an era in the history of the petroleum industry. For many years after the birth of the oil industry, most of the oil wells in the world were drilled with simple wooden rigs (No. 1). Such a rig, called a standard cable tool rig, stood about 60 to 65 feet high and cost something like $750 to build. It could drill a hole to a maximum of 4000 feet at a cost of $80 a day. Most wells drilled with rigs of this type, however, were seldom over 2000 feet deep.

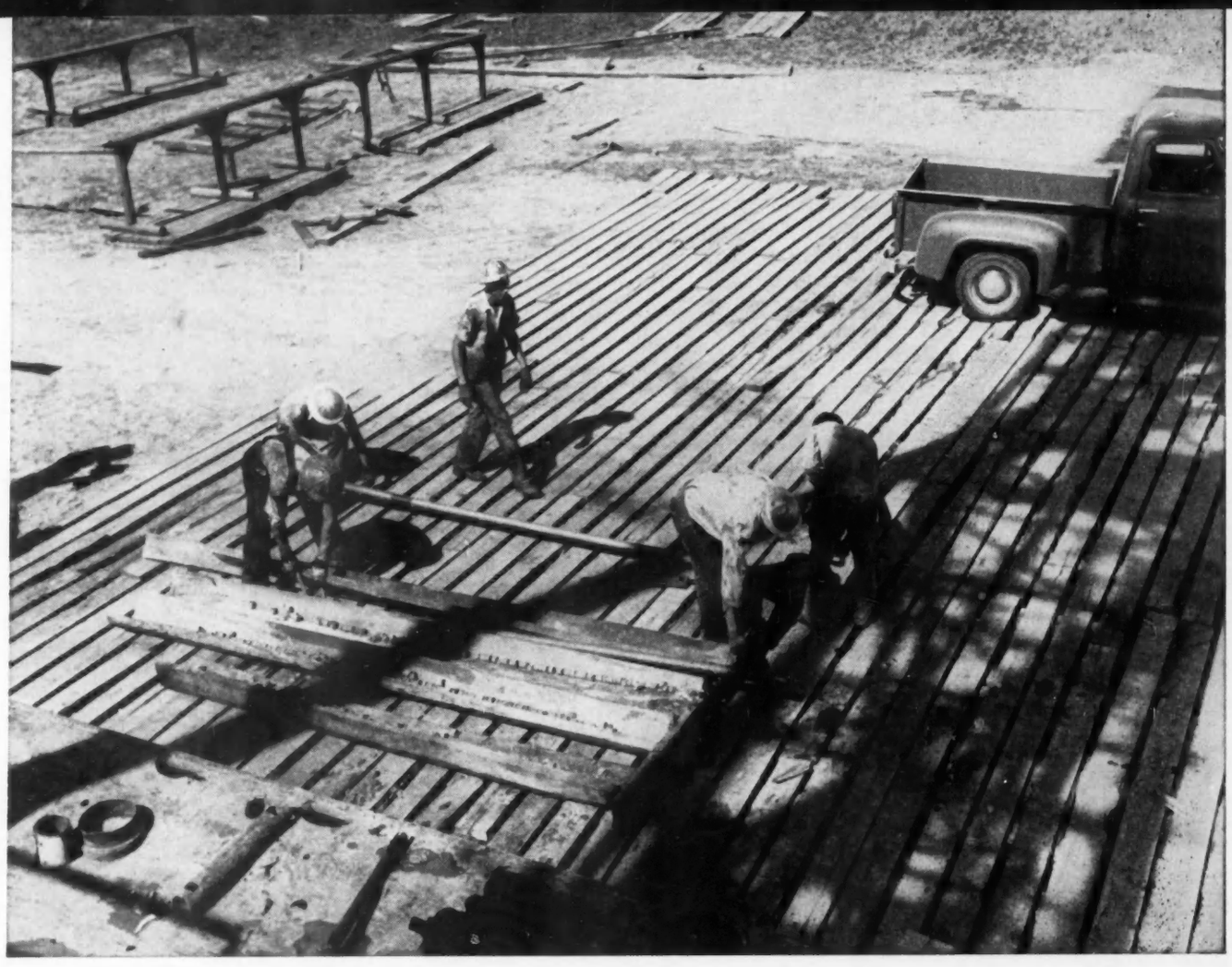
Oil men soon decided that there was oil to be found at greater depths. This need resulted in development of rigs like No. 2, called a conventional steel rotary rig, which permitted faster and deeper drilling. Originally about 126 feet high and costing in the vicinity of $18,000, it is still being widely used in modern versions. Holes over three miles deep have been drilled with them. The cost of operating such a rig was about $1000 daily.

But the standard rotary had a disadvantage. It had to be dismantled and rebuilt for each new well location. This led to the design of a portable rig (No. 3), which could be transported virtually intact. So efficient are these rigs that wells have been drilled to depths of 7000 feet in less than two weeks. Such a rig costs approximately $250,000 to build and $1200 a day to operate.

Then came the discovery of oil beneath the sea. Obviously, none of these drilling rigs was intended for marine operation, although several were adapted for this purpose by mounting them on various types of floating or stationary platforms in comparatively shallow water.

The latest development is a new type of equipment designed expressly for offshore drilling. One of the newest is Mr. Gus (No. 4), owned by drilling contractor C. G. Glasscock of Corpus Christi. It is a floating steel "island" complete with crew's quarters and all drilling equipment. It stands as high as a seven-story building and is capable of drilling in up to 100 feet of water. Built at a cost of $3,500,000, it was first used by Shell Oil Company off the Texas coast. The daily cost of operating a rig like this is $6000 a day.

These developments have all come so rapidly in the comparatively young industry that there are men in the business today who have worked with all the different types of equipment pictured here, which stand as mechanical monuments to the ingenuity of resourceful men and untold expenditure of money. —**The End**



A man with a bad back does not belong on a drilling rig. Pre-employment physical examinations are a must in your organization.

Is Your Insurance Covering?

These are fast-changing times in the drilling industry. Have you kept abreast with your workmen's compensation and general liability programs?

By R. B. HAGENS, Langham, Langston and Burnett, Houston

THE CONTINUING UPSURGE in offshore drilling and exploration, plus some recent developments regarding land operations, make it advisable for drilling contractors to examine their workmen's compensation and general liability insurance closely.

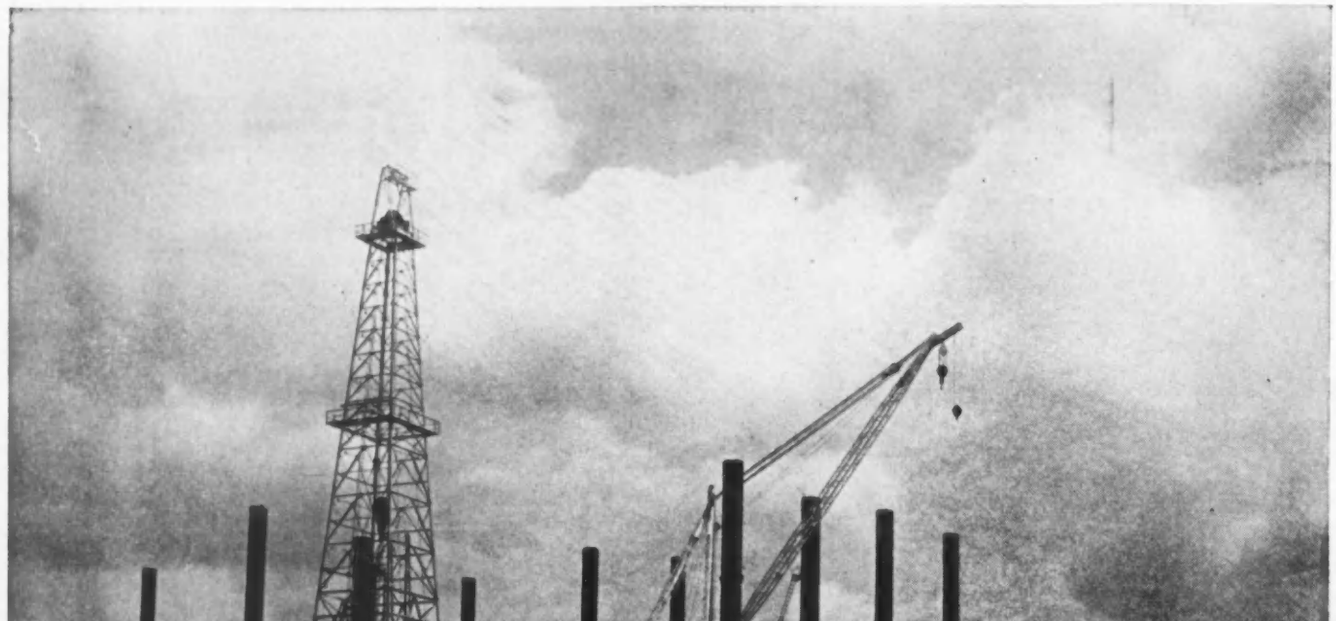
Developments and new problems involved are:

- Workmen's compensation for offshore operations.
- Workmen's compensation for land operations.
- General liability.
- Safety considerations affecting both workmen's compensation and general liability.

Among the important problems are additional endorsements needed to protect the drilling contractor in offshore operations; recent revisions in the standard Workmen's Compensation policy and their effect; the danger of "assumed liability" when not specifically covered; and safety procedures which can help to cut accidents and thereby reduce insurance costs:

Workmen's Compensation

Offshore. The mechanics of writing Workmen's Compensation coverage for drilling operations offshore in the Gulf of Mexico are considerably different from those used in writing cov-



A major hazard in offshore operations is loading and unloading men and supplies from crew boats. Some of the newer offshore barges minimize this danger to some extent with helicopter landing decks.

erage for operations strictly on land.

If a contractor contemplates drilling operations offshore he should contact his insurance agent well in advance of the proposed operations and be sure that his Workmen's Compensation policy has been properly endorsed to cover the offshore operations.

Depending upon where the well is being drilled, the operations may involve (a) the Workmen's Compensation Act of an individual state, (b) the U. S. Longshoremen's and Harbor Worker's Compensation Act as extended by Public Law 212 of the 83rd Congress, and (c) the Jones Act relating to seamen. Therefore, the drilling contractor should make absolutely certain that the following endorsements have been attached to his Workmen's Compensation policy:

1. U. S. Longshoremen and Harbor Worker's Compensation Act Endorsement.
2. Outer Continental Shelf Operations Endorsement.
3. Voluntary Compensation Endorsement.
4. Amendment of Voluntary Compensation Endorsement-Maritime Operations.
5. Amendments to Coverage B Endorsement-Maritime.

After the contractor has had his Workmen's Compensation policy properly endorsed so that it will cover under the State Act, the Longshoremen and Harbor Worker's Compensation Act and the Jones Act, he should give consideration to the proper limits of liability, which he requires in connection with Coverage B-Employer's Liability.

Land Operations. Generally speaking, Workmen's Compensation coverage for land operations is not too involved, but there are some very important provisions, particularly in Texas, which should be well understood. The Workmen's Compensation Law of the state in which operations are under way applies.

The Workmen's Compensation standard policy was revised some months ago, and it is now permissible to attach to the Workmen's Compensation policy what is known as an "All States Endorsement." This endorsement will extend the policy to cover in all of the states of the U. S. except those states which have Monopolistic State Funds.

Many of the State Workmen's Compensation laws have extra-territorial provisions. Texas, for instance, provides that if an employe who was hired in Texas, sustains injury in the

course of his employment, he shall be entitled to compensation according to the law of Texas even though such injury was received outside of Texas. It is provided, however, that such injury *shall have occurred within one year from the date such employe leaves this state;* and provided, further, that no recovery can be had by the injured employe in the event he has elected to pursue his remedy and recovers in the state where such injury occurred.

Since there is always a possibility that a drilling contractor may start operations in additional states after the policy has been issued, it is a good idea for the contractor to see that his Workmen's Compensation policy has an "All States Endorsement" attached at the time the policy is issued.

General Liability

In connection with General Liability coverage there are several points which a drilling contractor should note carefully:

- The standard Comprehensive General Liability policy applies "only to accidents which occur during the policy period within the U. S., its territories or possessions or Canada." If the contractor contemplates doing work offshore, he should see that his liability policy is endorsed extending the territory to cover operations in the Gulf of Mexico.

- It is possible for an insurance company to so write a General Liability policy that it will not afford any coverage for property damage due to explosion, blowout or cratering of a gas or oil well. Since these are very real risks insofar as a drilling contractor is concerned, he should make sure that his policy has been written to include coverage for these risks.

The standard General Liability policy also has an exclusion with regard to the use of water craft if the accident occurs away from premises owned, rented to or controlled by the insured. Should the drilling contractor start any operations which involve the use of boats of any kind, he should contact his insurance agent and see that the proper coverage is arranged.

- There is another very important item which the drilling contractor should keep in mind. The standard General Liability policy does not apply to liability assumed by the insured under any contract or agreement, with the exception of certain defined agreements which a drilling contractor ordinarily would not have.

Since most contractors do have a written contract with the owner or operator, this contract should be thoroughly examined for "assumed liability"—that is, liability which the contractor has agreed to take over and which would not ordinarily be his legal liability. These contractual agreements may be insured under a General Liability policy, but the policy must be so drawn as to include them specifically. Otherwise the contractor may be unprotected on an assumed liability.

Safety Activities

A good safety program is not only sound human relations, but a good investment in dollars and cents.

The losses which the insurance company is called upon to pay, either under Workmen's Compensation coverage or General Liability coverage have a very definite effect upon the cost of future insurance. Both the Workmen's Compensation and General Liability are subject to experience rating. A period of three years is used to develop the experience modification, and if the contractor is able to control his losses he is able to secure very substantial credits. An effective safety program is one of the best means of reducing injuries and controlling losses.

Many of the larger contractors during recent years have had their insurance written on a "Retrospective Rating Basis." When written on this basis an adjustment is made some time after the policies expire and the amount of the premium that the contractor pays depends upon the loss experience of the contractor for the particular year involved. When the insurance is written on this basis the contractor can get almost immediate benefit from an effective safety program.

In offshore operations, one of the greatest hazards today is in connection with the loading and unloading of men and supplies from a crew boat or supply boat to the drilling platform or tender. Proper procedures, training, and adherence to safety rules are basic in any program of reducing injuries during these operations. Pre-employment physical examinations are particularly important in connection with oil field operations. The job is hazardous at best, and in order to minimize accidents it is essential to have men who are in good physical condition. If, by medical examination, the contractor finds that the prospective employe has a hernia or a "bad back" he may be able to save a claim which would cost several hundreds of dollars in additional premiums because of a poorer experience rating.

Another point that should be mentioned is the use of "escape lines" in connection with drilling rigs. There seems to be a wide difference of opinion among oil drillers and safety engineers as to the advisability of equipping the rigs with an "escape line"; however, it is felt that a majority think that they are worthwhile.

During the past year there have been several fires in which the derrick man was caught in the derrick without an opportunity to escape, and certainly if an escape line had been provided, the man would have had a better chance to escape without serious injury.

Another safety feature which has been adopted by some contractors is the use of roofing paper on the drilling floor. It is a very difficult problem to keep the floor from becoming slick, but experience indicates that if the mud is kept flushed off and the roofing paper is used the opportunity for "slips and falls" is very much minimized.

The Safety Color Code prepared by the safety committee of the American Association of Oilwell Drilling Contractors is an example of other procedures which may be used to reduce accidents. Under the code, rigs and equipment are painted as follows for constant recognition and alertness to special hazards:

RED—To designate fire equipment, apparatus and installations.
YELLOW—(alternate diagonal strips of yellow and black): To point out strike-against, falling and stumbing hazards such as stairways, rat-hole casing or raised platforms.
YELLOW (bright)—For similar hazards that move, such as traveling blocks, rotary hoses, and swivels.
ORANGE—To warn against cut, bite, pinch, explosive and electrical shock hazards.
GREEN—For first aid equipment, bulletin boards and safety signs.

—The End

THE NEW MAN ON ANY RIG

This Man Is Dangerous,

SOUTHEASTERN DRILLING COMPANY of Dallas has tied a red flag of warning on the most dangerous object in the drilling industry.

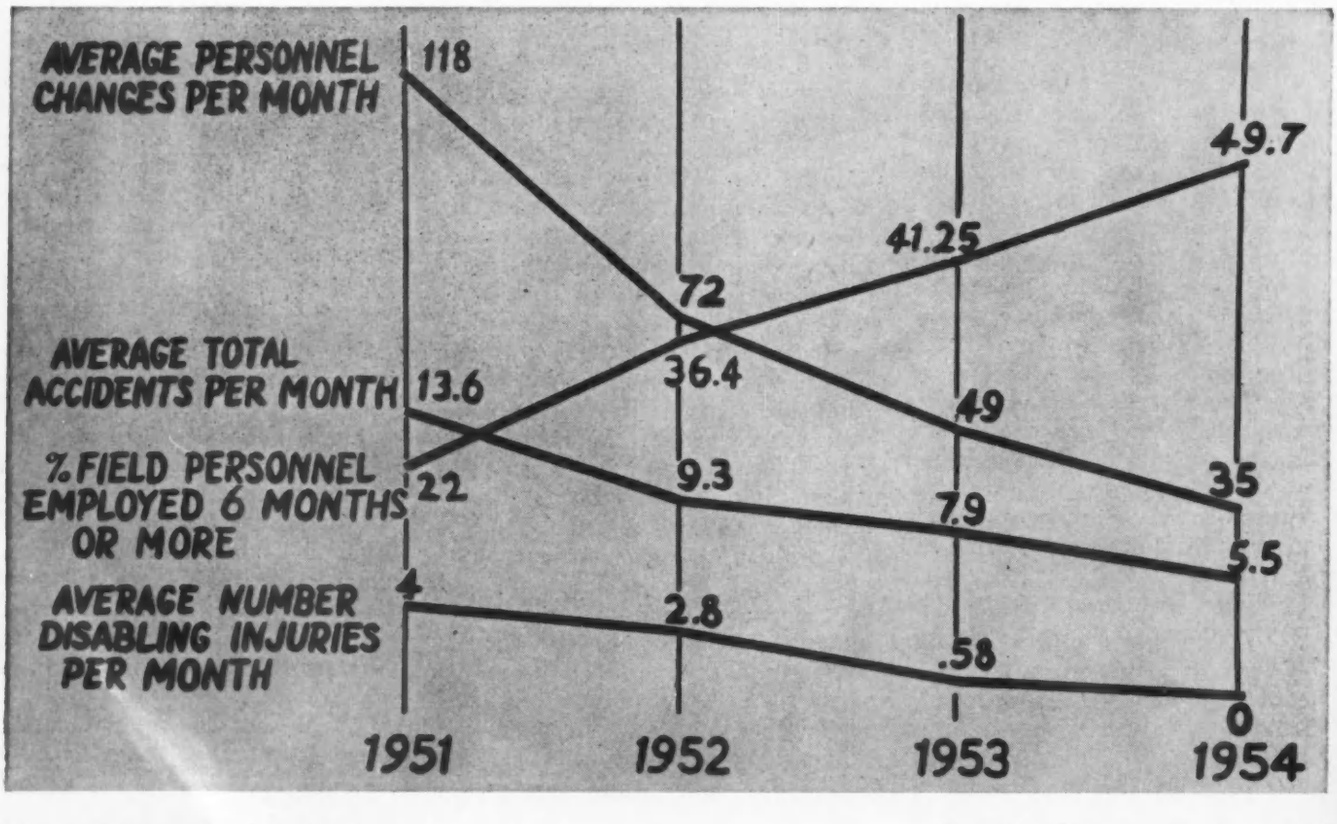
That object is the new man on any rig.

This is the latest move in a program which promises to save thousands of insurance dollars for a company which just five years ago suffered the indignity of having its insurance canceled because of the frequency of its accidents (see Figure 1). Oddly, it also is one of the few out-and-out safety measures by a firm recently honored by the American Association of Oilwell Drilling Contractors "for operating eight rotary rigs throughout 1954 with a total of 426,467 man-hours without a lost-time accident."

There is some doubt, indeed, as to whether Southeastern has a safety pro-

IT RESULTED IN THIS . . .

FIGURE 1—This is the story of Southeastern's personnel program for 1951-54. The number of accidents declined as the stability of the work force increased.



but . . . Southeastern Drilling Company tied a red bandana on him and it worked!

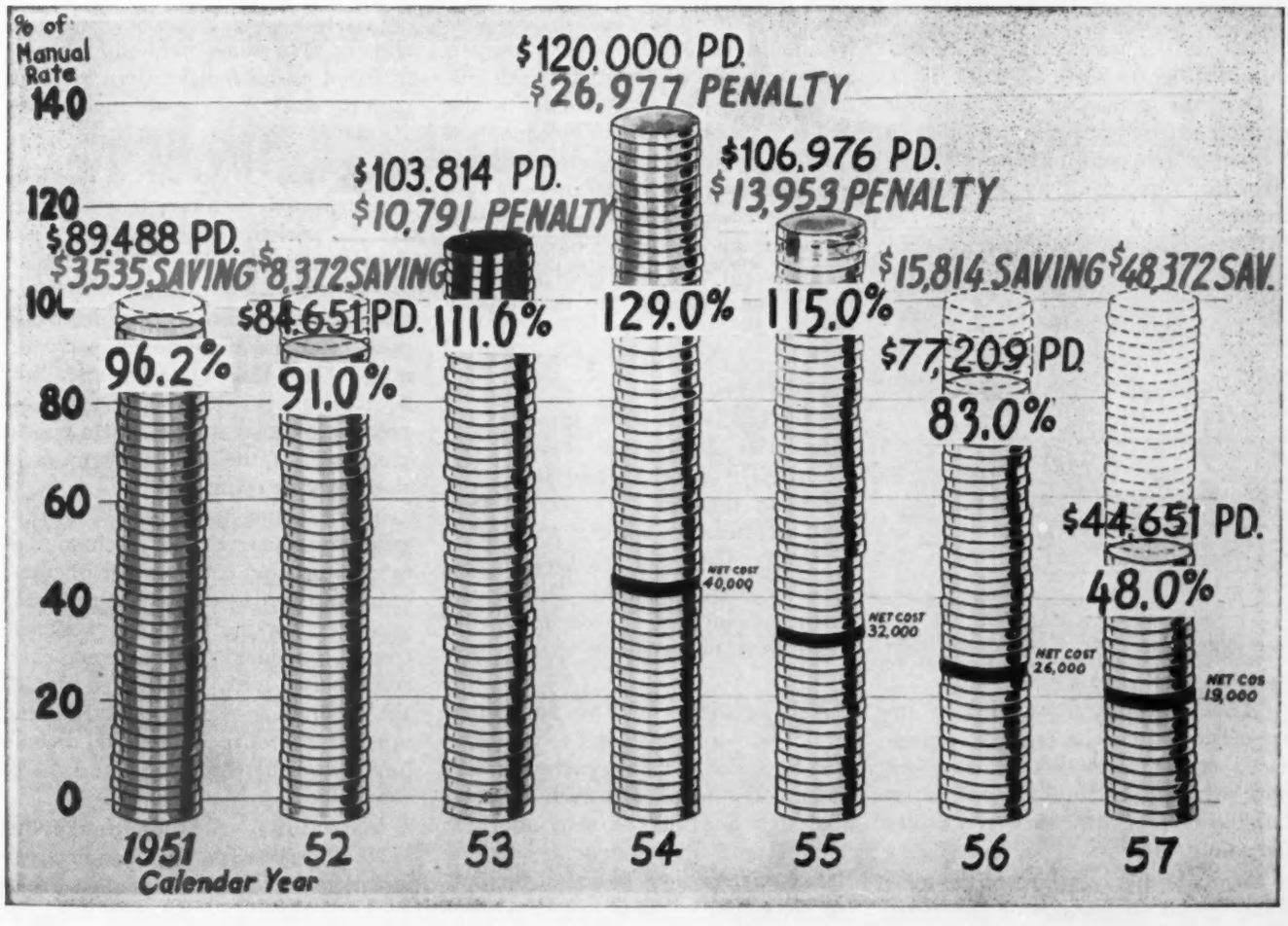
gram as it is commonly defined. President W. P. Clements, Jr., prefers to call it a personnel program, a term which correctly implies that safety is only one of several interlocking objectives. It is Southeastern's philosophy that emphasis on safety without consideration of the factors which underlie safety is to attempt to make the tail wag the dog. People must have an incentive to work safely that is above and beyond the fear of injury.

How it began. This is not to say, however, that safety was not the prime mover of the benevolent program drafted by Southeastern in 1950. The company had bought eight rigs from Creole Petroleum Corporation the year before, bringing its total to 13. The accident frequency rate promptly jumped and the insurance was canceled.

Management went into urgent huddle. Routine safety preachments had failed. There was need to approach the problem from a different direction. It was recalled that the influx of new employes hired for the rigs bought from Creole had coincided with the increase in accidents. This suggested the desirability of a work force trained in teamwork, familiar

. . . MORE CHANGE

FIGURE 2—Dramatic evidence of the insurance savings that can be effected by a good safety record. The chart is based on a manual rate of $93,000 as being 100 percent. The solid dollars represent total premiums paid by Southeastern Drilling Company through 1954. Premiums for 1955-57 are projected on the basis of the same 6 percent loss ratio as in 1954. A company which does not have a participating or retrospective insurance plan would, under this loss ratio, pay $106,976 for 1955, $77,209 for 1956, and $44,651 for 1957. Since Southeastern's plan is Retrospective "D", its net cost would be $32,000 for 1955, $26,000 for 1956, and $19,000 for 1957. The shaded dollars for 1954-55 represent the penalty premium paid by Southeastern because of an unfavorable loss ratio in prior years.



R. J. Moran, chairman of the AAODC Safety Committee, at left, presents a special award to President W. P. Clements, Jr., and Secretary W. E. Armentrout of Southeastern in recognition for having had no disabling accidents in the company during 1954.

with the machinery used by the company—in short, an experienced work force. Experience of that sort is acquired only through stability. To keep a good crewman it is necessary to keep him contented.

Such is the essence of the Southeastern program.

That the reasoning was sound is attested by some statistics included in a letter which goes out to every new man, accompanied by a red bandanna:

"One third of Southeastern's total accidents happen to men that have been with Southeastern LESS THAN 30 DAYS.

"Here is the actual count of accidents that occurred for the years 1953 and 1954:

	1953	Pct.	1954	Pct.
"Men with Southeastern less than 30 days	29	32	23	34
"Men with Southeastern more than one month and less than six months	30	13	17	26
"Men with Southeastern more than six months	32	35	27	40
	91*	100	67*	100

* None of the 1954 accidents and only six of the 1953 accidents were disabling.

"These injuries occurred to inexperienced men as well as experienced hands. Experienced men got hurt primarily because they were not familiar with how the crew and driller did things, and vice versa. In an effort to eliminate this one-third of the total injuries, Bill Clements, our president, had the idea of asking men that had been with Southeastern less than 30 days to wear a red bandanna around their neck or arm until they have been with the company 30 days. This is to serve as a reminder to the man that he should watch the other crewmen as well as the driller during this 30-day period. Also, it's a flag to the driller and the other crewmen to watch you and help you get acquainted with the operation of the rig. The company believes if you will cooperate and wear this bandanna as suggested, it will help keep you from getting hurt during the first 30-day period.

"The new men in West Texas were asked if they would object to wearing the bandanna. They agreed to try it and thought it might help . . . SO . . . LET'S TRY IT and see if you can't get through your first 30 days with Southeastern without an injury."

Southeastern now averages 35 personnel changes a month. During the first two months of the bandanna plan there were no accidents among new men.

It is significant that the bandannas go not only to weevils but to men who may have had years of experience with other companies. It is even conceivable that a driller be thus adorned. This is unlikely, however, because of the company's rigid policy of promoting from within. Ninety-eight percent of Southeastern's drillers worked up from roughnecks within the company.

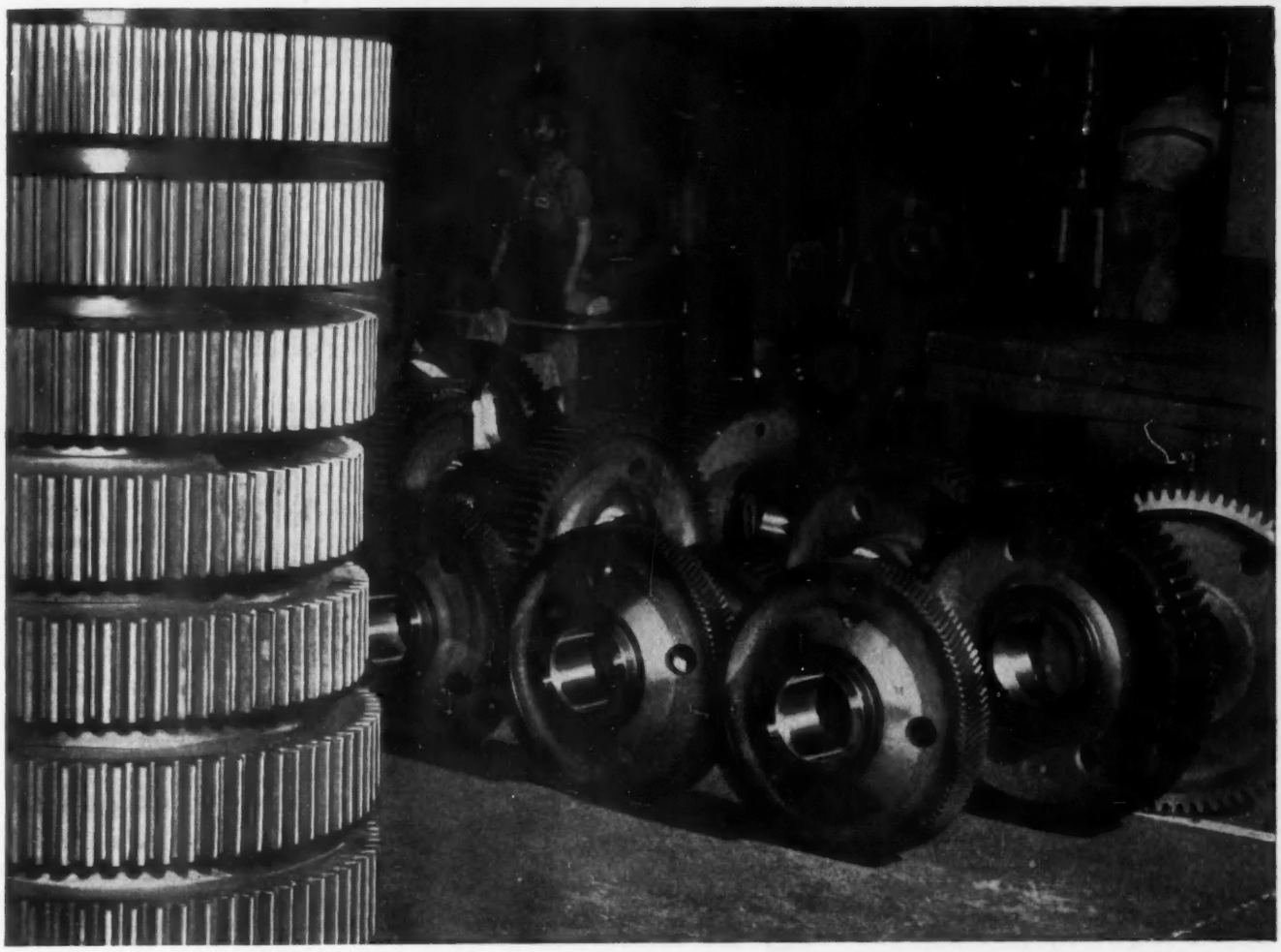
The high accident frequency among men with experience but new to the company pointed up the need for standardizing rig practices and machinery. The same methods are now followed on all Southeastern rigs. All pumps, drawworks and engines are standardized.

Safety aids. Major aids in familiarizing new men with company practices are the periodic meetings. Rig crews meet weekly and are required to send in suggestions to management for safer, more efficient operations. Toolpushers attend these meetings once a month. Toolpushers, drillers and management meet once a month. Toolpushers and management meet once a month. Thus, the lines of communication are wide open.

These factors in Southeastern's program emphasize the mechanics of safety, with job contentment involved only to the degree that a man appreciates working for a company sincerely concerned with keeping him from being hurt. The remainder of the program is beamed directly at the original objective of keeping people happy and therefore stable and therefore safe:

Vacations—A roughneck who works a year without a lost-time accident gets a full week's paid vacation.

Continued on Page 99



Good, Strong Gears Begin with Good, Strong Blanks

Because strength is usually the first requirement in a gear, Bethlehem devotes unusual care to the making of gear blanks. And equally important, Bethlehem has developed a process of manufacture that assures high strength *without* excessive weight.

This process is unique; there is nothing else like it. First, a heated round is placed in a special mill where it is upset, forged and rolled in a single operation. The resulting blank is dense, homogeneous, compact; the grain flow of the steel is smooth and uniform.

These characteristics go hand in hand with strength. Moreover, blanks made by this method are easy to machine, and fewer cuts are required in a good many cases.

When making gears—spur, bevel, miter, helical, and others—you can rely completely on Bethlehem blanks. But their use is not confined to gears alone. In fact, they're excellent for a long list of applications—crane wheels, industrial wheels, turbine rotors, clutch and brake drums, sheave wheels, flywheels, pipe flanges, tire molds, etc. The blanks are available in sizes from 10 to 42 in. OD, and can be furnished treated or untreated.

If you would like more complete information, write for a copy of Booklet 216. It will be sent to you promptly without cost or obligation.

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Norman Haney (right) pusher for Thomas P. Pike Drilling Company, learns firsthand from Ray Marsh of the Accounting department, how foreman's field reports are processed in the home office. Instructions were part of a Foreman's Training Course at firm's main office.

Foremen Training Courses Reduce Costs and Accidents

Pike Drilling Company has proven that a drilling foreman properly trained can be an important factor in saving money and preventing mishaps.

By GENE GRAHAM, Executive Vice President,
Thomas P. Pike Drilling Company, Los Angeles

THE ACCOUNTING DIVISION of a contract drilling firm has no other accurate source of field data and reports except from the toolpushers. They are virtually human timeclocks, and management must rely completely upon foreman for clean records which are often the difference between profit and loss.

If a drilling foreman has received formal training in company paperwork, both in the field and in the main office, he can be an important factor in reducing costs. If he can visualize the course of his paperwork in the accounting department and coordinate his records accurately with the main office, he can eliminate the major part of waste that comes from incomplete reports, back-checking and inaccuracies which are a problem of the whole industry.

A year ago Thomas P. Pike Drilling Company decided that a program of formal training in office work for toolpushers might be another practical step in the campaign to eliminate waste of every kind, including waste motion. Since the firm operates under a plan of incentive management with profit sharing, it was not hard to interest the foremen in such a campaign, because, under this plan, employes from all levels have a voice in management and an opportunity to discuss such moves at advisory board meetings.

At these meetings, the group discusses current contracts, profit and loss statements and methods of reducing waste. Ideas for better drilling techniques and other management considerations are exchanged, and the decisions of the board either become company directives, or are sent as recommendations to the board of directors for further action.

It was easy not only for the foreman to see that a course of instruction might be a means of swelling the profit-sharing fund but that it could also make their individual jobs easier.

Three-quarters of the force have now been through the course, and results have been everything that had been hoped for. All men promoted to the rank of foreman are required to take the course before they take over their rig.

The course. The training course is not given on any regular time schedule. Only one man at a time is brought in from the rigs. As far as possible, his instruction is timed with some period when the rig is idle.

At the beginning, each pusher is exposed directly to the mechanics of payroll accounting, with all the complications of deducting for withholding taxes, government insurance, savings and other details. One and one-half days of actual clerical work on this important division of accounting has proved sufficient to give him the entire picture and to impress him with the Accounting department's payroll problems and the necessity for absolute accuracy.

Time is then spent in studying accounts payable routine. Invoice classifications are explained and allocation of costs studied, until the pusher has a thorough understanding of the importance of this accounting division

and the relationship of his own paperwork to it.

In the Estimating department, each foreman is given the opportunity to cooperate in compiling actual bids. He fills out estimate blanks, analyzes cost factors, and is finally given actual estimates to work on, which are often submitted as bids after checking by the staff. This way he becomes aware of overhead and depreciation, in addition to direct operating costs. These two important items are too often forgotten. The field man may even be unaware of them in his picture of company operations.

Company responsibility and obligation to perform, once a contract is signed is emphasized carefully during the entire course. It is made plain that heavy responsibility rests upon the foreman for the type of performance which satisfies the client and builds good will for future business relations. He is taught the nature of the liabilities assumed by the contractor once a contract has been signed; he is shown that, win or lose, the job must be completed as agreed, and that default in any way is out of the question. He must, therefore, conduct the management of his rig to satisfy all concerned.

Safety stressed. The importance of the safety program is stressed in the training course, from the humanitarian aspects of preventing loss of life or suffering and for the bearing insurance loss ratios have upon compensation premiums and, consequently, on the firm's net profit and profit-sharing plan. In this regard, the company's work in enlisting the cooperation of the foremen for safer operation has reduced the accident average by 40 percent during the last year, and, as a consequence, earned a rebate of $50,000 in permiums.

Finally, the foreman spends time in the main office studying administration of the company's profit-sharing plan, the employe retirement fund and the so-called fringe benefits, such as free life insurance, health insurance and other features of the company pay package. A close-up view of these activities has helped materially to improve accuracy of the foremen's paperwork which must coordinate with the necessary accounting of these items.

About the Author

GENE GRAHAM, executive vice president for Thomas P. Pike Drilling Company, Los Angeles, graduated from California Institute of Technology with a degree in mechanical engineering. After graduation, he went to work for Baker Oil Tool Company in 1935 and was with this firm until 1941. He was plant manager for The Grant Tool Company from 1944-1948. He became assistant to the president of Rocky Mountain Drilling Company in 1948 and remained with this firm until 1951, when he joined Pike as vice president and general manager. He was made executive vice president in 1954.

Efficiency increased. All of these various phases of the foreman training program have had a marked effect in improving the over-all operations of the company. The trainee leaves the main office with a better understanding of the importance of accurate reports and other paperwork. He can better visualize the needs of the main office for supplementary information, thus anticipating time-consuming inquiries. But above all, he is brought to a full realization of the importance of his job and of the fact that the firm must depend completely upon him for accurate field information. After he has had the course of instruction, he has little excuse for errors due to carelessness or indifference. In departments where his reports coordinate with the work of others, their eyes are upon him, demanding careful cooperation. He realizes that he cannot afford to be wrong or half sure.

—The End

This Man Is Dangerous

Continued from Page 92

A driller is entitled to two weeks, a toolpusher three.

Bonuses—Based on company earnings and individual seniority. A roughneck with five years of service receives more than a driller with one year.

Insurance—Everyone receives a $1000 paid-up life insurance policy after six months with the company. After two years this is increased to $6000. There is also a group hospitalization plan paid for by the employes. While voluntary, everyone subscribes.

Training—Chosen employes attend the various AAODC schools.

Barbecues—A crew that works 60 days without an accident is given a barbecue, complete with cowboy band. Families are invited. A driller on one rig becomes acquainted with the toolpusher on another, thus easing the problem of transfers.

One other important factor in the company's improving safety record has been work continuity. A rig stacked for any length of time usually means new faces, more accidents on the next job. In 1953, Southeastern was able to keep its rigs busy an average of 84 percent of the time. Last year the figure was 78 percent.

The success of this effort to achieve a stable work force is such that President Clements and Secretary W. E. Armentrout are beginning to wonder what the optimum figure should be. The percentage of field personnel who have been with the company six months or more is now 49.7 (Figure 1). How much higher can the seniority curve mount before "dead wood" begins to collect on the payroll? "Some say 60 percent," Clements declares. "I frankly don't know."

Chances are he will have the opportunity to find out if the company maintains the policies reflected in one end of a conversation overheard recently. It was on a Saturday morning and Southeastern's outer office was steeped in that stillness peculiar to places usually alive with clattering typewriters, hurried voices, quick footsteps. Down the deserted hall drifted the voice of someone on a telephone: "No matter how bad it seems, Harvey, don't worry about it. The company will take care of you, I'm sure."

—The End

Mr. Gus Moves . . .

Top view: Under command of the Jennifer George and the Porpoise, a combined force of nearly 2000 horsepower, Mr. Gus moves toward the new location.

Captain Styx pilots the tug Jennifer George toward the drilling barge Mr. Gus.

TOWING AN OFFSHORE drilling platform is about like towing a ship. At least that's what Captain Horace F. Styx says. And Captain Styx has towed both. As skipper of the tug, Jennifer George, for instance, he has assisted in spotting the mammoth offshore rig, Mr. Gus, at all three of its locations.

If it's run-of-the-mill to experienced tugmen, moving the big drilling platforms is anything but routine to the drilling companies which own them.

Marine architects and fabricators have perfected designs to withstand hurricane weather and battering seas. The hydraulic raising and lowering devices can be controlled with watchmaker accuracy. But from the time the legs and barge are clear of the bottom until they are down again, the fate of a multi-million dollar rig such as Mr. Gus is in the hands of two small ships which could be carried on the deck of the portable rig with room to spare.

Mr. Gus was most recently moved July 18 and 19. The trip involved 19 miles from a point five miles offshore in 28 feet of water to a location 13 miles offshore in 81 feet of water. Both locations are near Aransas Pass and Padre Island in the Gulf of Mexico off the coast of Texas.

On Friday, July 15, the towing company was told that the move would start in a matter of days and Captain Styx's Jennifer George and the Porpoise, commanded by Captain B. T. Orange, were assigned to the job. Captain Styx was put in charge. Both tugs were engaged in harbor work in Galveston at the time.

The tugs were finally dispatched at 5 p.m., Sunday, July 17, returning to their berths on Wednesday, July 20.

The crews were capable and experienced. Coast Guard licensing testifies to their ability and the tugs' seaworthiness. They made the 80 hours of work—from looping to towing hawsers over the bitts of the rig to tying up again at Galveston—look simple.

But there were problems, that even the men on Mr. Gus didn't know. For instance, with so much of it above water and with few streamlined features, the drilling platform is affected by wind.

In addition, since Mr. Gus was being towed into deeper waters, 27 feet of the 12 steel legs were left below sea level. As a result, Mr. Gus was caught by a strong westerly set in the sea current.

This, in turn, took a mile an hour off the three-mile-per-hour speed at which previous tows have progressed.

Unlike the usual pointed-hulled ship with a rudder, Mr. Gus, with its barge base is steered entirely by the tugs. Despite some variations in horsepower and size, the two tugs on the recent tow appeared to be matched like a pair of show dogs because of the close liaison between the two crews. Actually the Porpoise is 100 feet long and develops 1050 horsepower. The Jennifer George is 88 feet long and has 920 horsepower.

By almost unnoticeable changes in course or in distance between the tugs, they shepherded the portable steel island between the two buoys which marked the new location. The tugs were given a 150 margin. Without maneuvering, they made it on the first try and held the barge in position for hours while the spuds were put down.

"We could spot it on a dime if they wanted us to," Captain Styx explained. In previous tows, he has been given as little as 50 feet of leeway.

—The End

MODERN ALL GEAR & TORQUE TUBE PRIMARY DRIVE

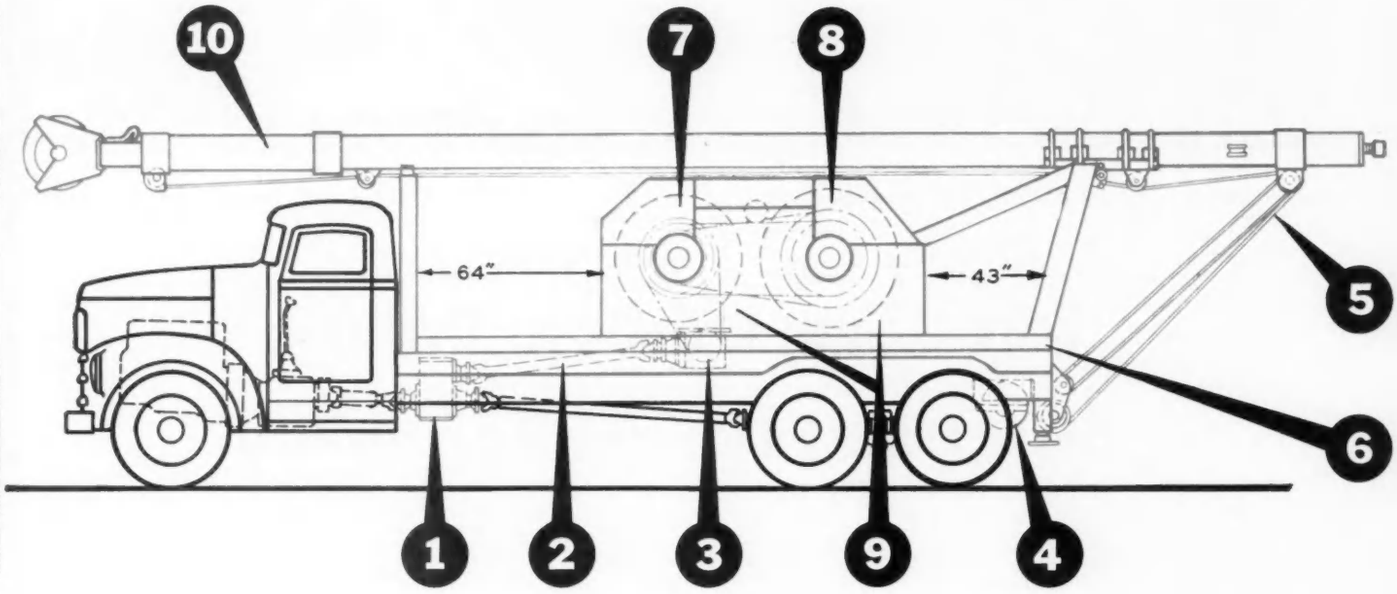
The COOPER TR Servicing Units have been designed to overcome the usual objections to large truck units.

Note on the diagram below that the power is transmitted through gears, torque tube and *short* slow speed heavy chains, actually eliminating chain and sprocket wear, noise and troublesome adjustments.

The load is balanced over the weight bearing axles, permitting higher road speeds and more maneuverability in the field.

Note, that lines go directly from drum to crown of mast leaving rear of bed free of dangerous running sheaves and that ample free bed space is provided in between cab and drum housing. The unit can carry a full crew and tools to the job.

The operator's view of the well head is clear. All clutches are finger tip, air valve controlled. All transmission speeds are conveniently obtainable at operator's position.



1. Constant mesh helical gear power transfer — sealed in oil.
2. Torque tube drive to countershaft.
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4. Auxiliary winch for operating mast.
5. Mast is raised and telescoped by same line, no lost time spooling line off and on drum.
6. Control position optional for operator, on folding platform or on ground.
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9. Mechanically equalized Brake Bands lined with API Blocks. One point adjustment.
10. Telescoping single or double pole masts and fabricated guyless derricks.

Write for additional information or ask the Cooper Sales Engineer in your area.

The most complete line of well servicing equipment. There is a proper size and type to fit any depth well or any field condition. You can service them faster, safer and at less cost with a COOPER.

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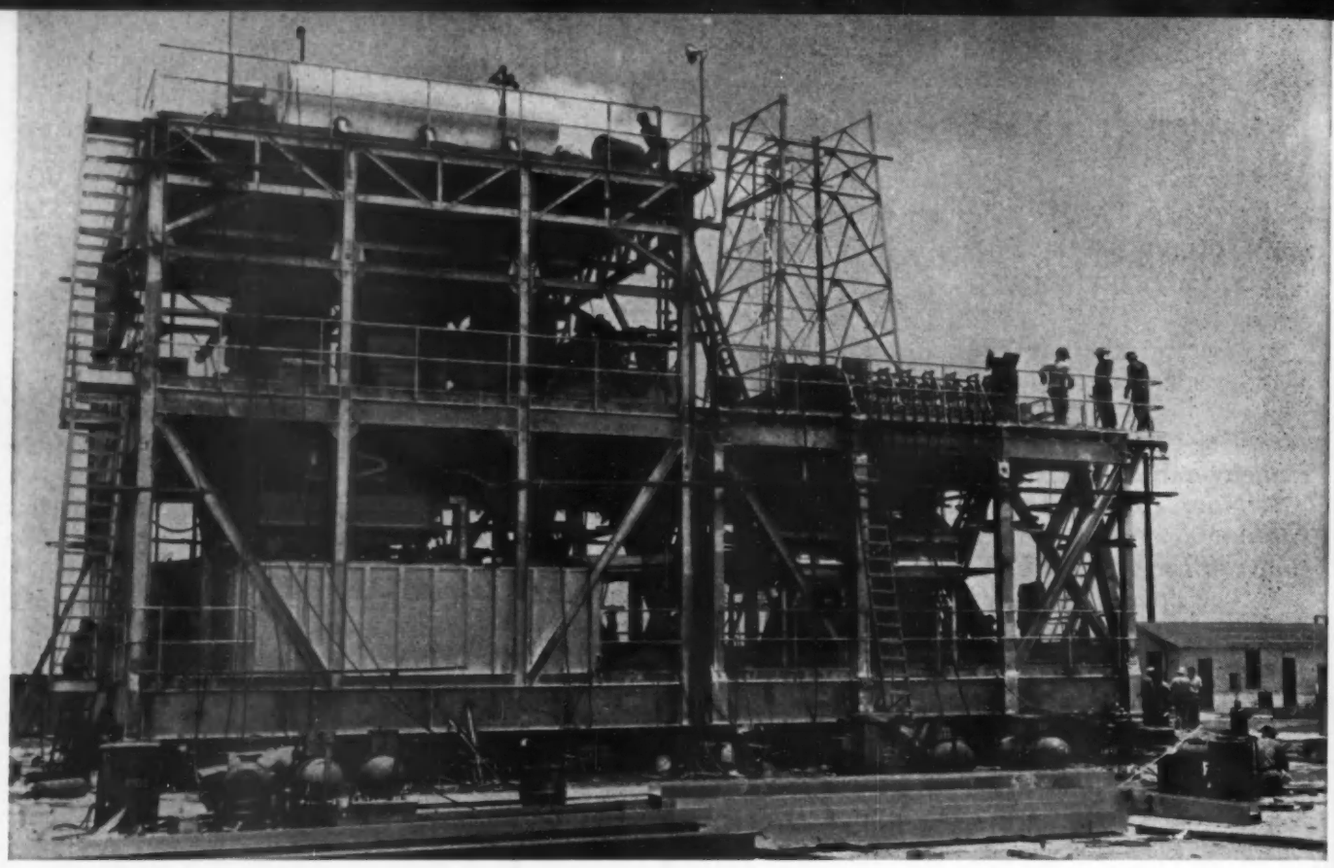

The Salt Dome structure is readily adaptable for service aboard a barge or on a platform. Designed in four units, structure transfer is a simple and speedy operation.

Salt Dome Offshore Drilling Structure Features Portability

AN ALL WELDED prefabricated derrick and engine structure has been completed at a New Orleans shipyard for Salt Dome Production Company. The structure is designed so that it can be handled in four lifts; the derrick sub-structure, complete with all machinery, equipment, piping and weighing approximately 157 tons; the logging unit platform (upper engine structure), complete with equipment weighing 45 tons; the engine structure complete with three engine compound, mud pump, mud tanks, weighing approximately 184 tons. The drawworks weighing approximately 30 tons is the only piece of machinery handled individually.

The entire structure can be skidded onto the offshore platform for drilling several wells and is limited only by the extent of the platform. All three sections of the structure are pinned or bolted together and, upon completion of the drilling operation at any given location, can be dismantled in a matter of hours and ready for moving to a new location.

The derrick substructure is 30 by 40 feet (column centers), to accommodate a 30-foot base derrick. Height from the skid beams to the top of the wood deck is 19 feet. The rotary load is 600,000; the set back capacity 450,000 pounds; and the derrick capacity is 1,400,000 pounds.

The drilling floor is made of ¼-inch plate deck covered with 3-inch wood set in mastic, and is designed for loads of 400 pounds per square foot. The lower deck is covered with ¼-inch checkered floor plate. Provisions for handling sets of blowout preventers has been made. Other features of this portion of the structure include: handrails on both upper and lower decks, portable rotary beams, portable floor in way of rotary, and shale shakers and platform on the lower deck.

The engine structure is made in two parts. The lower structure is 30 feet, nine inches by 40 feet (column centers). The upper deck and its supports are a separate lift, and all three decks of the engine structure are covered with ¼-inch checkered plate, except in way of engines and compound, mud pump and mud tanks. On this part of the structure there are two mud tanks constructed of ¼-inch plate, an engine house, and a 50-barrel water tank and 50-barrel fuel oil tank on the upper deck.

Lifting eyes, similar to eyes on jacket and platform, are installed on all units of the structure. These eyes are recessed in decks and covered with portable plates. All machinery is skidded. Stairways are provided from lower to upper deck of derrick structure, from lower deck to engine structure, and from engine deck to electric logging platform. —**The End**

- ✓ Printing Invoices
- ✓ Cancelled Checks
- ✓ Post Office Receipts
- ✓ Circulation Record Transcript
- ✓ Count and Check of Mail List
- ✓ Condition of Collections
- ✓ Original Order Test
- ✓ Expirations
- ✓ Source of Subscriptions
- ✓ Mail Subscriptions Special
- ✓ Association Subscriptions
- ✓ School Subscriptions
- ✓ Subscriptions to U. S. Armed Services
- ✓ Arrears over Three Months
- ✓ Credit Subs. Cancelled for Nonpayment
- ✓ Short Term Subs. in Arrears
- ✓ Duplications on mail lists
- ✓ Circulation by Population Groups
- ✓ Geographical Analysis
- ✓ Term Subscriptions in Bulk
- ✓ Names for Verification Letters
- ✓ Back Copy Subscriptions
- ✓ Dealer Ledger Check
- ✓ Condition of Dealer Collections
- ✓ Dealer Returns
- ✓ Single Copy Sales
- ✓ Single Copy Sales to U. S. Armed Services
- ✓ Bulk Sales
- ✓ Premiums
- ✓ Promotion
- ✓ Contests
- ✓ Combination Sales
- ✓ Clubs
- ✓ Special Prices
- ✓ General Books and Controls
- ✓ Analysis of Disbursements
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The Check List Behind A.B.C. Circulation FACTS

Study the check list at the left. It's the one used by a field auditor of the Audit Bureau of Circulations when he makes his careful annual examination of our circulation books and records. The answers to questions like these appear in our A. B. C. Audit Report so that you can make your advertising investments on the basis of facts.

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The Audit Bureau of Circulations is a voluntary, nonprofit association founded forty years ago by advertisers, advertising agencies and publishers to bring order out of circulation chaos. The Bureau sets standards for net paid circulation, verifies circulation by field audit and issues A. B. C. Audit Reports.

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A.B.C. REPORT

WORLD OIL

A.B.C. — 40 YEARS OF IMPARTIAL FACT-FINDING AND FACT-REPORTING

Why Idleness Compensation Plans Are Unnecessary in Oil Industry

Guaranteed annual wage already has been practically established through the industry's efficient and continuous operations.

Existing steady jobs eliminate need for plans providing for supplemental unemployment compensation, such as auto industry adopted.

By WILLIAM E. ZIMMERMAN, Director of Industrial Relations,
Sun Oil Company, Philadelphia, Pa.

SUPPLEMENTAL UNEMPLOYMENT compensation plans, such as the automobile industry has adopted, are not applicable broadly throughout industry, and are not needed in the petroleum industry.

Such plans must be viewed as special programs designed to meet particular problems which have existed or now exist in certain industries. These problems are chiefly short work weeks and temporary layoffs.

Over the years, men and women in the petroleum industry have had little need for concern about steady employment. The industry stands in the forefront as a provider of steady employment. (At least 99 percent of the employes on Sun Oil Company's regular payroll right now have had steady, year-round employment as long as they have been with the company—and some have been with Sun for more than 50 years.)

The fact that the oil industry is outstanding in offering job security is borne out by records of the monthly rate of separations compiled by the U. S. Bureau of Labor statistics. This rate includes separations for all causes —those discharged, laid off, retired, or who resign, are disabled, or die. It indicates whether or not steady work is provided, as well as whether or not workers are satisfied to remain at their jobs.

For refinery workers, about one person per hundred is being separated in a month. For all manufacturing generally, the rate is from four to five times higher. There are no comparable published figures for other branches of the oil industry. But observation indicates that experience in production and transportation is about the same as in refining. Marketing, which includes employment of temporary help service station attendants and fuel oil truck drivers, probably has a somewhat higher separation rate than the other branches.

There are a number of reasons why oil workers in general do not suffer from short weeks and layoffs. Here are five of the most significant:

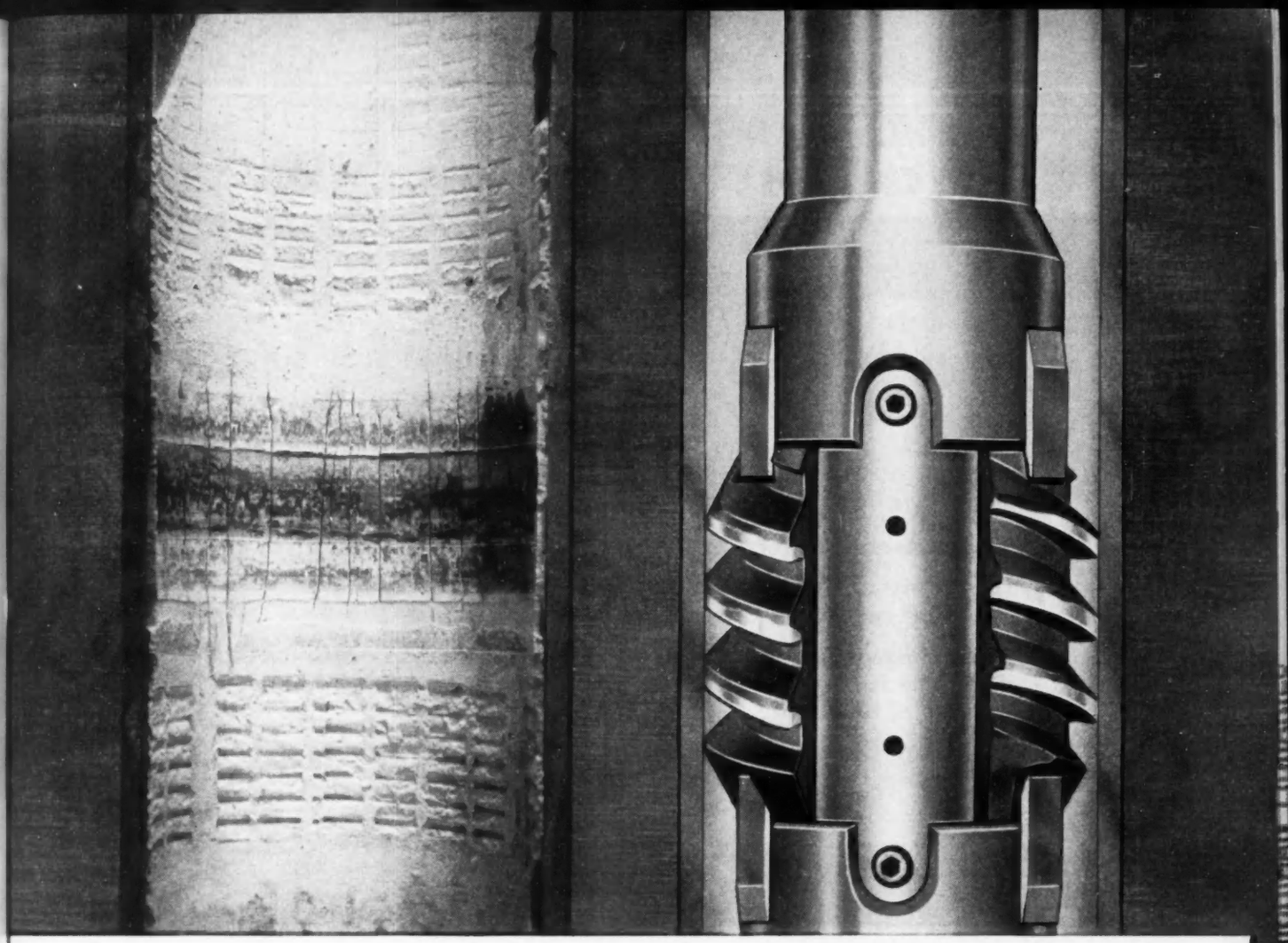
1. Demand for oil products has grown decade after decade, making expansion possible and resulting in a sweeping rise in overall petroleum employment. The growth in demand over the years has been speeded by improvements in the quality of petroleum products, by the development of new products to meet new needs, and by the fact that improvements in efficiency have generally reduced costs that are reflected in product prices.

2. Many oil products have become necessities. They are purchased on a year-round basis, during good times and bad. Thus, the question of layoffs during so-called slack periods seldom, if ever, arises in most segments of the industry.

3. Although not true in early years, the oil industry today achieves uniformity of operations during the year by building up gasoline stocks in winter and spring and fuel oil stocks in summer and fall. This method of operation is but one of a number of things done by the industry to stabilize employment and to make operations profitable throughout the year.

4. The oil industry, in a sense, is like a huge industrial belt line. Most of its operations are on a 24-hour basis. Thus, unlike some industries, there is no "stop and go" about the oil business, and work, as a consequence, is relatively steady.

5. The oil industry utilizes a relatively large amount of capital investment for each worker employed. Because of depreciation charges and other reasons, there is a substantial cost to owning and operating capital equipment. This cost differs from the cost of employing labor in that management cannot eliminate it simply by "laying off" the capital equipment. Therefore, management will normally



CAN YOU AFFORD *Not* to scrape your casing ...*the Baker way?*

You can't buy insurance for each job—so do the next best thing . . . keep your casing clean with the . .

BAKER

This is just another way of asking "CAN YOU AFFORD THE EXPENSE OF DOWN-HOLE EQUIPMENT FAILURES?" The unretouched photograph at the above left provides visual proof of how casing neglect can cause even the best pack-off tool to fail.

In this case the pack-off tool set and packed-off perfectly—but the casing ID failed to do its part. Notice the cracks in the cement sheath in the area where the Packing Element was packed-off. *These cracks allowed the fluid under pressure to by-pass, even though the tool was securely set and completely packed-off.*

The Baker Roto-Vert Casing Scraper, which can be run on tubing, drill pipe or wire line, completely removes cement sheath and other obstructions such as perforation burrs and imbedded bullets—prepares the casing ID for subsequent work with pack-off tools. Remember, the condition of your casing ID is just as important to the successful operation of pack-off tools as the condition of a valve seat is to the operation of a valve.

Why take chances with so much at stake? The safe, positive, economical way to eliminate failures, such as the one illustrated above, is to make the running of a Baker Model "C" Roto-Vert Casing Scraper a part of your standard operating procedure.

BAKER OIL TOOLS, INC. • HOUSTON • LOS ANGELES • NEW YORK

ROTO-VERT
CASING SCRAPER
PRODUCT NO. 620-C

5 reasons why oil workers have not suffered from short work weeks, layoffs . . .

1. **Growth in demand for oil products, leading to a "sweeping rise" in over-all petroleum employment.**
2. **Non-seasonal nature of demand for many petroleum products.**
3. **The practice of building up gasoline stocks during the winter and fuel oil stocks during the summer.**
4. **Round-the-clock operations in refineries and in other branches of the industry, which keep the industry humming like a huge industrial belt line.**
5. **Relatively large amount of capital investment for each worker employed, making continuous operation essential.**

strive to keep its capital equipment in operation, which means, of course, that it must keep the necessary personnel employed.

These reasons why the oil industry offers steady employment are strictly economic. They are based on the realities of the market and the overriding necessity to operate profitably. No other basis can possibly prove sound over a period of time. Certain economic facts are immutable, and bargaining, legislation, or generous intentions can never change them.

One such fact, for example, is that a company must earn profits to stay in business. Another is that a company cannot earn profits in the long run unless its costs are less than the selling price of its products. And a third is that the effective selling price of products is determined by the free market —that is, by customers.

Those are the economic facts of life that every business must accept. They are as significant to employes as they are to management. In effect, they mean that the security of employes' jobs and the maximum compensation they can receive are both keyed directly to the value of the products they produce and the efficiency with which they produce them. In other words, employes must earn through production their own job security, their own wages, and their own employe benefits.

Generally speaking, if employes would concentrate on helping their employers to operate efficiently enough to meet competition, they would make a substantial contribution to assuring their continuous employment.

As a matter of fact, a trend toward greater stability of employment in industry is already evident. Many firms have diversified their operations to eliminate seasonal employment. The oil industry builds stocks of gasoline and fuel oil during slack seasons and schedules inside and outside work so that certain employes can work in both winter and summer.

As machinery and operations become more complex, employers find that the cost of training new personnel mounts. Consequently, there is increased incentive to retain experienced personnel even during slack periods.

It has been forecast that production will increase 29 percent between 1950 and 1960, while the total labor force will increase but 12 percent. This indicates that labor will be at a premium in the years ahead, and employers will put even greater emphasis than in past years on keeping their work forces intact.

So, it is not indicated that steady employment will be a critical problem in the future, provided that a business climate exists which stimulates enterprise, induces efficiency, and encourages research and innovation.

Those are the conditions of progress, and they are the requisites of earned security—the only kind of security that can endure.

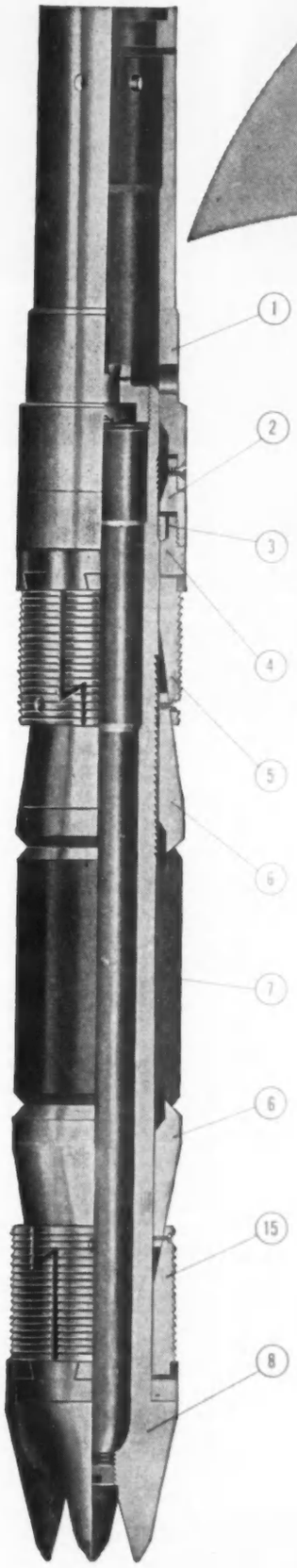
ACKNOWLEDGMENT
Excerpted from Sun Oil Company's magazine, *Our Sun*, Summer, 1955.

LET'S TAKE A LOOK INSIDE OF A

LANE WELLS COMPANY

TECHNICAL OIL FIELD SERVICES

DRILLABLE WIRELINE BRIDGING PLUG



and see how and why it gives such positive packoff against pressures either up or down

1. Ram Adapter, to transmit downward pressure of setting tool. It may be removed after the plug is set.
2. Lock Ring Adapter forms a housing to enclose the lock ring and prevent its movement after engagement with the body.
3. Lock Ring, triple-wickered, engages wickers on the body to prevent any unsetting action after packoff. Both lock ring and seat are tapered so that, the greater the external pressures, the tighter the locking action.
4. Slip Locking Ring acts as a guide for the slips, which are dovetailed into it, insuring even movement and equal pressure against the casing on all sides.
5. Upper Slips support the body against pressures from below and prevent upward movement of the set plug.
6. Cone. The two cones force the slips against the casing and expand the packing sleeve for leak-proof packoff.
7. Packing Sleeve of oil-and-gas-resistant synthetic rubber is double-lipped, with a wire in each lip, to insure positive packoff and fast running without premature expansion. The greater the differential pressures, the tighter the seal.

15. Lower Slips, keyed to the body, prevent downward movement of the set plug from upper hole pressures.
8. Body. The foundation of the plug. In drilling out, the body drops to bottom after the lock ring grip is broken. The bull plug fins, tapered to guide the plug into liners or other restricted passages, prevent rotation under the bit when the entire plug is to be drilled up.

If you don't have your copy of the new, revised Lane-Wells Bridging Plug Bulletin, write for it now. It gives full details on construction, applications and drillout procedures.

UL-80-A

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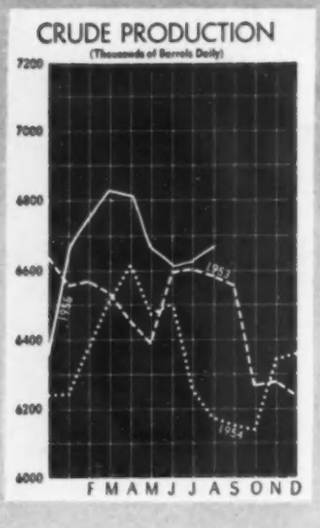
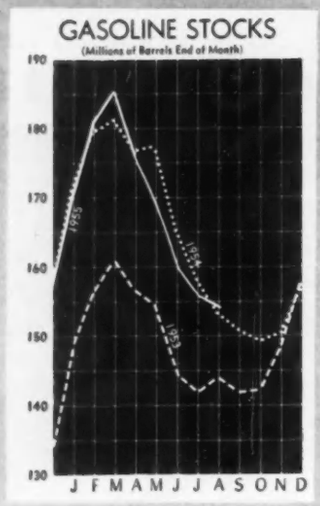
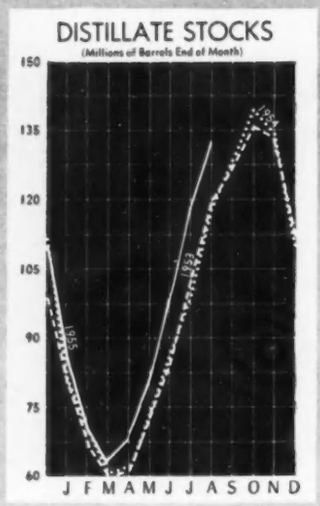
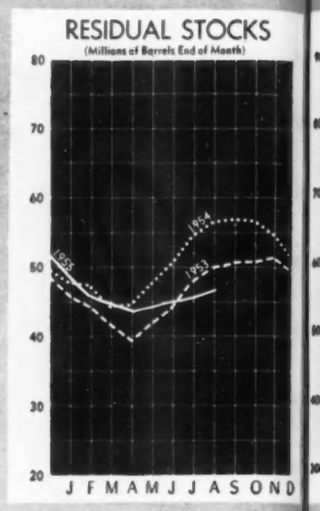
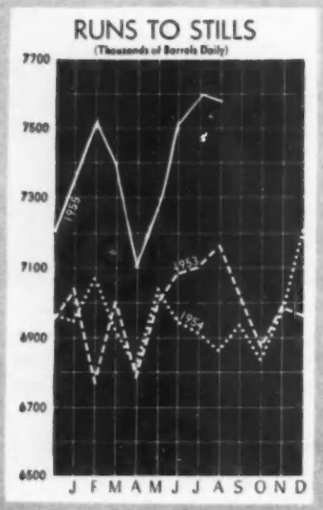
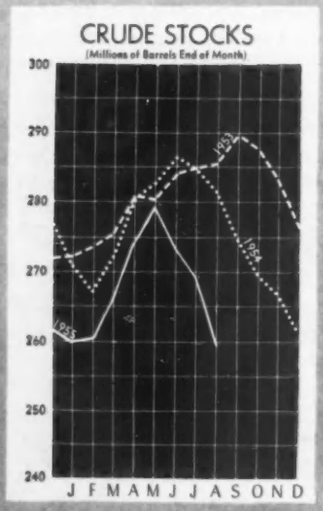












Petroleum Trends in U. S. . . .

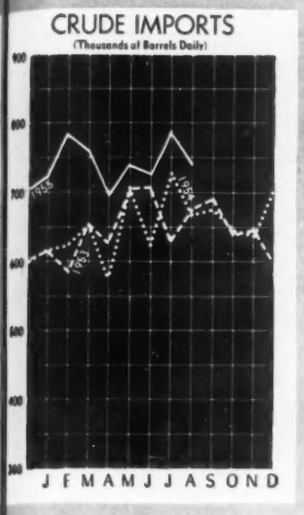
By CECIL W. SMITH, WORLD OIL Staff

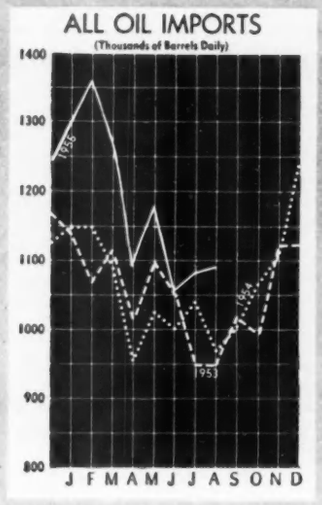
U. S. Crude Production by States

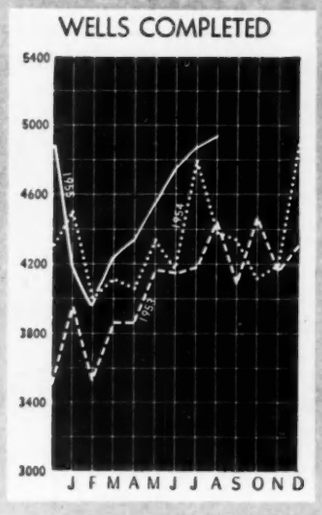
(THOUSANDS OF BARRELS)

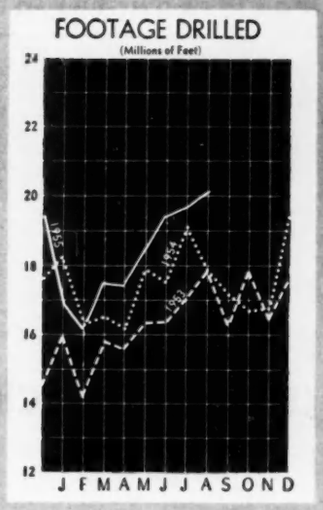
STATE or DISTRICT	DAILY AVERAGE PRODUCTION August, 1955	July, 1955	August, 1954	% Diff. August, '55-'54	TOTAL PRODUCTION First Eight Months 1955	1954	% Diff. '55-'54
Alabama	4.0	3.5	3.9	+ 2.6	889	1,068	— 16.8
Arkansas	73.9	74.4	76.6	— .7	18,833	19,746	— 4.1
California	978.5	973.3	957.6	+ 2.2	236,250	238,785	— 1.1
Colorado	150.5	147.1	116.5	+ 2.3	32,599	26,513	+ 23.0
Florida	1.4	1.4	1.6	— 12.5	319	373	— 14.5
Illinois	237.4	234.4	176.6	+ 34.4	54,398	43,300	+ 25.6
Indiana	31.0	29.8	29.7	+ 4.0	7,292	7,564	— 3.6
Kansas	328.6	322.5	320.6	+ 2.5	80,304	79,734	+ .7
Kentucky	43.0	41.0	36.7	+ 11.7	9,876	9,029	+ 9.4
Louisiana	719.9	712.8	640.2	+ 12.4	174,254	168,096	+ 3.7
North Louisiana	116.6	117.7	107.2	+ 8.8	28,680	27,653	+ 3.7
South Louisiana	603.3	595.1	533.0	+ 13.2	145,574	140,443	+ 3.7
Michigan	30.8	31.4	32.6	— 1.9	7,636	8,082	— 5.5
Mississippi	101.2	100.1	88.8	+ 14.0	23,699	22,455	+ 5.5
Missouri	0.2	0.2	0.2	.....	52	56	— 7.2
Montana	45.4	45.6	40.8	+ 11.3	10,739	8,775	+ 22.4
Nebraska	29.5	29.0	20.1	+ 46.8	6,157	4,767	+ 29.2
New Mexico	227.9	225.8	206.5	+ 10.4	54,135	49,400	+ 9.6
Southeast New Mexico	226.3	224.2	204.6	+ 10.6	53,518	48,906	+ 9.4
Northeast New Mexico	0.6	1.6	1.9	— 68.4	617	494	+ 24.9
New York	10.8	11.0	8.6	+ 25.6	2,136	2,180	— 2.0
Nevada	0.1	0.2	.....	.....	44	.....	.....
North Dakota	33.2	37.3	14.3	+132.2	7,099	3,495	+103.1
Ohio	12.4	11.1	8.6	+ 44.2	2,791	2,534	+ 10.1
Oklahoma	553.2	550.2	487.0	+ 13.6	133,536	126,847	+ 5.3
Pennsylvania	21.9	21.4	24.3	— 9.9	5,480	6,296	— 13.0
South Dakota	0.1	0.1	0.2	— 50.0	23	20	+ 15.0
Tennessee	.....	.....	.....	.....	9	11	— 18.2
Texas	2,734.2	2,721.3	2,593.7	+ 5.4	700,344	658,348	+ 6.4
Dist. 1—South Central	49.3	48.6	41.6	+ 18.5	12,380	10,187	+ 21.5
Dist. 2—Middle Gulf	141.7	139.3	130.4	+ 8.7	36,573	35,089	+ 4.2
Dist. 3—Upper Gulf	433.0	439.3	423.4	+ 2.3	110,963	107,714	+ 3.0
Dist. 4—Lower Gulf-S.W.	230.2	227.8	226.0	+ 1.9	59,488	60,073	— 1.0
Dist. 5—East Central	47.9	47.4	42.4	+ 3.0	11,652	10,837	+ 7.5
Dist. 6—Northeast	995.0	321.0	315.7	+215.2	84,170	84,215	— 0.1
Dist. 7-B—North Central	143.0	139.8	125.4	+ 14.0	34,265	30,513	+ 12.3
Dist. 7-C—West Central	173.6	174.2	174.8	— .7	45,176	44,060	+ 10.3
Dist. 8—West	908.2	902.2	817.8	+ 11.1	228,022	208,243	+ 9.5
Dist. 9—North	195.1	191.8	179.3	+ 8.8	48,180	45,467	+ 6.0
Dist. 10—Panhandle	90.0	89.9	83.6	+ 7.7	21,325	19,952	+ 6.9
Utah	6.6	5.8	4.3	+ 53.5	1,396	1,253	+ 11.4
Virginia	0.1	0.1	0.1	.....	12	6	+100.0
West Virginia	6.5	6.8	8.1	— 20.7	1,595	1,975	— 19.3
Wyoming	284.2	285.6	269.1	+ 5.6	66,502	62,310	+ 6.7
Total United States	6,666.5	6,623.2	6,167.4	+ 8.1	1,638,399	1,553,018	+ 5.5

Source: Bureau of Mines and API. Texas districts data from API and do not necessarily agree with state totals.









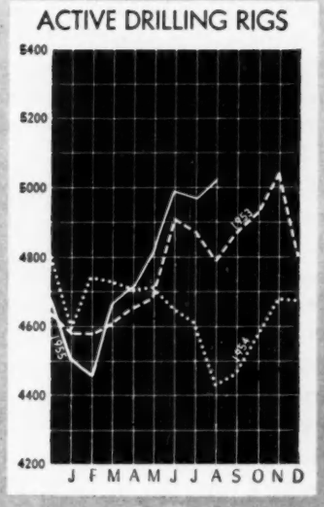
- **Completed wells hit monthly peak**
- **Active rigs reach 20-month high**
- **Crude output makes small gain**

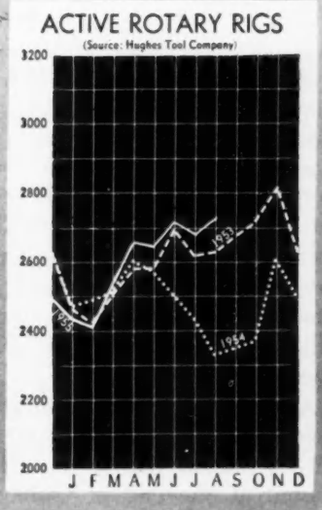
Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1953:											
June	6,595	7,081	283,715	3,467	146,196	1,462	84,504	1,238	43,801	707	1,050
July	6,603	7,103	284,976	3,583	143,916	1,441	102,394	1,224	47,966	629	946
August	6,583	7,163	285,352	3,592	146,050	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	1,462	135,409	1,184	50,820	639	990
November	6,277	6,987	283,021	3,528	150,747	1,463	133,381	1,223	51,267	648	1,120
December	6,238	6,964	276,676	3,628	159,949	1,441	111,944	1,247	49,370	598	1,121
1954:											
January	6,240	6,947	270,811	3,431	171,704	1,550	81,044	1,271	47,474	617	1,143
February	6,379	7,068	266,918	3,476	179,950	1,545	70,390	1,241	47,119	621	1,144
March	6,507	6,923	271,867	3,375	181,297	1,458	60,270	1,168	44,249	654	1,088
April	6,615	6,811	280,310	3,404	177,006	1,374	61,721	1,140	44,362	574	950
May	6,471	7,038	282,250	3,482	177,606	1,372	73,581	1,148	47,009	708	1,021
June	6,500	6,947	285,155	3,483	165,404	1,399	86,325	1,123	50,216	624	999
July	6,242	6,916	284,894	3,480	158,010	1,416	101,657	1,089	54,365	724	1,038
August	6,168	6,862	281,043	3,492	153,168	1,453	117,579	1,069	56,322	664	966
September	6,151	6,939	274,608	3,511	150,916	1,514	128,061	1,086	56,702	672	999
October	6,135	6,834	269,442	3,457	149,661	1,545	139,128	1,066	56,541	642	1,065
November	6,346	6,975	264,566	3,530	150,604	1,622	133,886	1,120	54,891	636	1,104
December	6,394	7,238	258,385	3,605	155,400	1,668	108,144	1,187	52,105	729	1,301
1955:											
January	6,761	7,379	260,156	3,639	169,562	1,740	86,692	1,235	49,457	739	1,348
February	6,835	7,549	258,630	3,655	181,643	1,847	68,513	1,239	46,042	751	1,379
March	6,886	7,374	264,430	3,543	183,972	1,703	62,457	1,185	44,970	742	1,319
April	6,887	7,136	275,232	3,502	175,601	1,534	70,139	1,110	43,838	697	1,123
May	6,677	7,281	276,948	3,605	168,751	1,519	83,559	1,111	45,083	742	1,137
June	6,613	7,484	270,850	3,725	157,439	1,628	100,652	1,080	44,398	764	1,159
July	6,623	7,599	269,642	3,732	156,627	1,590	118,367	1,114	45,325	789	1,085
August	6,666	7,579	259,680	3,778	153,694	1,713	132,345	1,106	46,550	743	1,090
August 1955 Change:											
In Month	+43	—20	—9,962	+46	—7,067	+123	+13,978	—8	+1,225	—46	+5
In Year	+498	+717	—21,363	+286	+526	+260	+14,766	+37	—9,772	+79	+124
Week Ended:											
9–9–55	6,655	7,554	255,645	3,740	154,337	1,651	137,836	1,080	47,111	865	1,126
9–10–54	6,171	6,989	273,337	3,421	153,279	1,443	121,734	1,103	56,725	741	1,038

Source: Data for last two months from API; prior monthly data from Bureau of Mines.





By **RAY L. DUDLEY,** Publisher, and **WARREN L. BAKER,** Editor

Surplus Stocks Become Definite Threat

EXCESSIVE STOCKS became a more definite threat to the economic position of the U. S. oil industry during the past month. Despite a larger-than-normal increase in consuming rates, it appears that excessive refinery output is going to destroy the favorable conditions that have existed during most of 1955.

The continued high level of refinery operations was resulting in the production of both too much distillate fuel oil and motor fuel. Unless refinery runs are curtailed immediately, surplus quantities of both distillate and gasoline are to plague the industry during coming winter months.

Refinery runs have averaged better than 7½ million barrels per day since the first of June this year, 600,000 barrels more than in the same period of 1954.

In contrast with the unfavorable outlook for refined products, the U. S. crude oil situation is in excellent shape. Crude stocks have declined to 255 million barrels, a decrease of nearly 9 million barrels during the last four weeks and 22 million less than were in tanks at the end of May this year.

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PARTICULARLY CRITICAL is the outlook for distillate fuel oil. Surplus distillate supplies are almost a certainty, even if crude runs to refinery stills are curtailed drastically and at once. Although this became evident more than 30 days ago, there were no signs of refiners curtailing their output of distillate fuel oil.

Consequently, U. S. distillate fuel stocks rose another 15½ million barrels during the four weeks ended September 9, an average of more than 550,000 barrels daily. This was the same rate of growth that has taken place since the first of June.

As a result of these sharp additions, distillate fuel stocks totaled nearly 138 million barrels on September 9, only 1 million barrels less than the all-time peak that existed at the end of October, 1954. Since they will continue growing until the first of November, the industry seems certain to enter the winter heating oil season with far more distillate fuel oil on hand than ever before.

How much more they will increase by November 1 is the important question now. Only drastic steps can keep them below 145 million barrels, which would be 6 million barrels above the 1954 peak. Unless refinery runs are curtailed, they will exceed this amount.

At their current level, distillate stocks are 16 million barrels larger than at the corresponding period of 1954. A month ago they were less than 15 million barrels above year ago volumes. Since the end of March over 75 million barrels have been added to distillate stocks, in contrast with the addition of only 61 million barrels during the same period of 1954.

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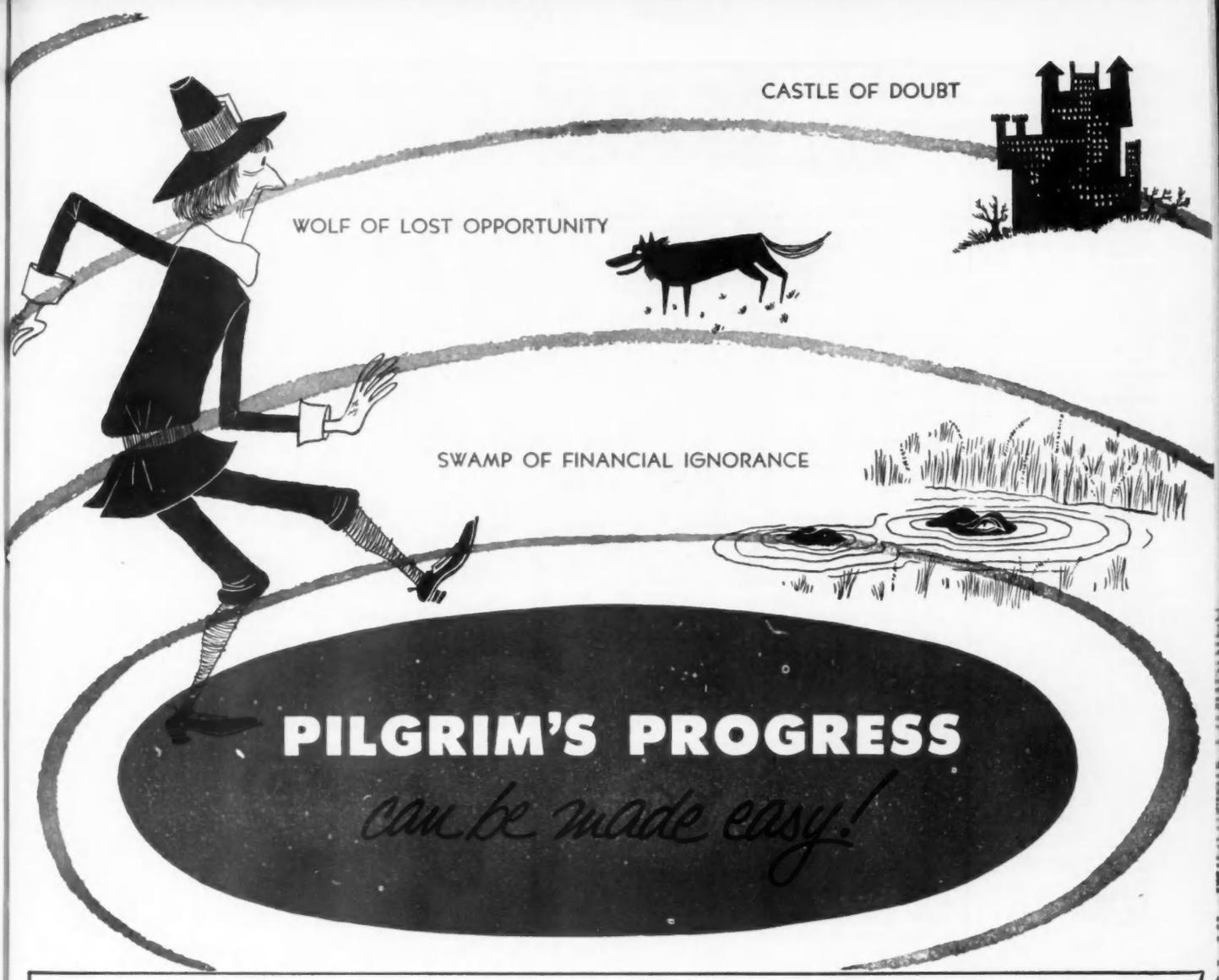
TOO MUCH GASOLINE also is in prospect. This represents a complete reversal of conditions during preceding months.

During the four weeks ended September 9, inventories of motor fuel declined less than 1 million barrels although this included the heavily-traveled long Labor Day week end as well as still being in the vacation travel season. Normally, gasoline stocks can be expected to decrease by about 5 million barrels during this period. Their failure to decline by any normal amount this year is simply a matter of making too much gasoline as a result of high refinery runs, since consumption was at an all-time peak during the period.

Consequently, gasoline stocks totaled 154⅓ million barrels on September 9. This was 1 million more than a year ago, although just two months ago the industry had 2⅔ million barrels less gasoline on hand than it did 12 months before.

Stocks of gasoline should be held to near this level through November. However, this is going to be difficult to do this year. Demand will taper off sharply henceforth. Continuation of refinery runs near their present level will result in sizable additions to stocks. This is another reason why refinery runs need to be curtailed immediately.



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MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

U. S. Wells Completed in August and First Eight Months, 1955-1954

STATE or DISTRICT	NEW WELLS COMPLETED AND FOOTAGE DRILLED — DETAILS FOR AUGUST: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	TOTAL NEW WELLS: Aug., 1955	July, 1955	Aug., 1954	Total Footage August, 1955	DETAILS FOR JANUARY-AUGUST — NEW WELLS: 1955	1954	Percent Diff.	FOOTAGE: 1955	1954	Rigs in Operation: Aug. 31, 1955	July 31, 1955	Aug. 31, 1954
Alabama				4				4	2	5	14,181	34	53	— 35.9	141,995	275,980	6	3	5
Arizona												4	8	— 50.0	16,136	30,774	1	1	5
Arkansas	36	2	1	43				82	82	57	316,769	495	372	+ 33.1	1,633,401	1,324,368	63	71	40
California	117		6	62				185	185	203	993,181	1,585	1,654	— 4.2	7,818,520	7,549,854	240	236	197
Colorado	43		10	79				132	143	120	693,092	991	862	+ 15.0	5,297,426	4,752,236	111	103	70
Florida				1				1	3	5	3,527	21	24	— 12.5	134,079	150,755	4	5	3
Georgia													7	—100.0		18,008	1	1	
Idaho									1			3			11,337				
Illinois	163		2	151				316	426	320	789,270	2,442	2,016	+ 21.1	5,919,436	4,940,282	348	333	288
Indiana	14		2	41				57	57	75	96,523	405	546	— 25.8	616,258	831,667	101	98	117
Kansas	184		20	146			1	351	421	347	1,258,659	3,052	2,796	+ 9.2	11,109,961	9,854,030	494	458	392
Kentucky	75		15	76				166	172	125	233,647	1,055	920	+ 14.7	1,673,393	1,729,380	131	137	78
Louisiana	204	21	23	97				345	331	358	2,367,766	2,695	2,332	+ 15.6	17,301,549	14,625,875	414	364	272
North Louisiana	109	4	10	38				161	166	196	504,100	1,370	1,213	+ 13.0	4,076,665	3,549,529	95	78	57
South Louisiana	95	17	13	59				184	165	162	1,863,606	1,325	1,119	+ 18.4	13,224,884	11,076,346	319	288	215
*Gulf of Mexico	12	2	3	9				26	22	19	244,339	203	143	+ 42.0	1,897,280	1,293,645	38	40	28
Maryland																	2	3	4
Michigan	23		1	27				51	36	44	155,969	337	362	— 6.9	1,001,492	949,379	95	93	111
Mississippi	8	2		12				22	35	46	151,936	300	272	+ 10.3	2,244,465	1,924,995	42	35	45
Missouri										1		24	9	+166.7	13,095	9,531	5	3	2
Montana	17			29				46	29	29	224,966	213	223	— 4.5	1,066,868	878,983	55	55	38
Nebraska	34		1	44				79	82	57	472,587	524	273	+ 91.9	3,038,956	1,510,607	56	54	20
Nevada										2		6	10	— 40.0	44,828	51,218	1	1	2
New Mexico	51	1	43	17				112	172	85	496,226	1,095	780	+ 40.4	4,680,916	4,171,066	147	158	119
New York	24				16			40	29	43	55,048	232	408	— 43.1	320,568	599,627	56	49	69
North Dakota	14			10				24	21	27	145,860	160	183	+ 2.6	1,137,330	1,268,460	26	25	28
Ohio	70		29	32				131	110	79	277,960	774	701	+ 10.4	1,628,228	1,359,928	223	212	196
Oklahoma	471	3	34	216	2		10	736	706	564	2,517,568	5,049	5,440	— 7.2	17,292,310	18,498,783	620	634	678
Oregon												1			7,101		1		
Pennsylvania	21		19	4	18	5		67	65	52	121,821	484	688	— 29.7	913,883	1,217,367	119	120	148
South Dakota				1				1		1	2,720	7	16	— 56.3	38,299	90,641	3	3	2
Texas	1,170	41	44	602	4		3	1,864	1,647	1,644	8,528,321	12,971	12,262	+ 5.8	57,265,789	55,419,996	1,339	1,383	1,227
Dist. 1: South Central	88		1	46				135	144	99	351,503	1,159	722	+ 60.5	3,042,027	2,425,892	54	50	31
Dist. 2: Middle Gulf	33	2	4	47				86	64	64	520,455	544	538	+ 1.1	3,262,348	3,219,930	44	49	35
Dist. 3: Upper Gulf	80	13	3	54				150	163	155	949,908	1,187	1,178	+ 0.8	7,605,330	7,990,397	137	136	116
*Gulf of Mexico		1						1	1		9,716	9			90,917		3	3	
Dist. 4: Lower Gulf-S.W.	48	12	6	54			3	123	100	112	675,721	913	987	— 7.5	4,832,258	5,130,525	81	87	72
*Gulf of Mexico		1						1	1		8,614	9			85,801		3	2	3
Dist. 5: East Central	5	2	1	14				22	21	26	77,922	180	188	— 4.3	701,825	715,444	13	14	13
Dist. 6: Northeast	25	6	5	25				61	70	53	333,798	463	472	— 1.9	2,534,991	2,792,331	57	65	60
Dist. 7-B: North Central	149	1	3	156				309	298	287	1,061,754	2,091	1,922	+ 8.8	6,669,023	6,238,636	165	160	134
Dist. 7-C: West Central	84		3	28				115	89	122	682,607	817	874	— 6.5	4,513,403	4,517,828	109	127	120
Dist. 8: West	390	1	1	62	4			458	271	268	2,564,000	2,542	1,951	+ 30.3	13,901,102	11,696,086	384	391	338
Dist. 9: North	209		1	106				316	370	351	981,144	2,428	2,761	— 12.1	7,906,865	8,484,903	215	228	236
Dist. 10: Panhandle	59	4	16	10				89	57	107	329,409	647	669	— 3.3	2,296,617	2,208,024	80	76	72
Utah				5				5	10	6	16,700	63	36	+ 75.0	291,964	178,046	24	23	23
Washington																			1
West Virginia	4		45	11				60	61	39	141,674	409	342	+ 19.6	1,061,843	976,282	188	190	170
Wyoming	26		2	34				62	73	87	294,087	476	810	— 41.2	2,340,637	4,309,370	103	114	89
Total United States	2,769	70	297	1,744	40	5	14	4,939	4,899	4,421	20,375,058	35,907	34,405	+ 4.4	146,062,063	139,497,488	5,019	4,965	4,439
Total Western Canada	203		11	104			4	322	284	259	1,389,923	1,691	▲1,387	+ 21.9	7,193,519	5,517,094	220	209	109

* Gulf of Mexico wells are included in their respective district totals.

Drilling Effort at Peak

152 Louisiana rigs now below 10,000 feet.

ANOTHER U.S. DRILLING record was established in August as the nation's drillers completed 4939 new wells to top the previous all-time peak reached a month earlier. The previous high had been 4899 completions recorded in July. August's record-breaking drilling results were also substantially greater than the 4421 new wells finished the same month a year ago.

Drilling rigs have been put to work in steadily increasing numbers since the outset of the year until a total of 5019 was busy by the end of August. That count was the greatest since November, 1953, when 5047 rigs were in use. With the large number of drilling units employed, the remainder of the year should see activity of a high order.

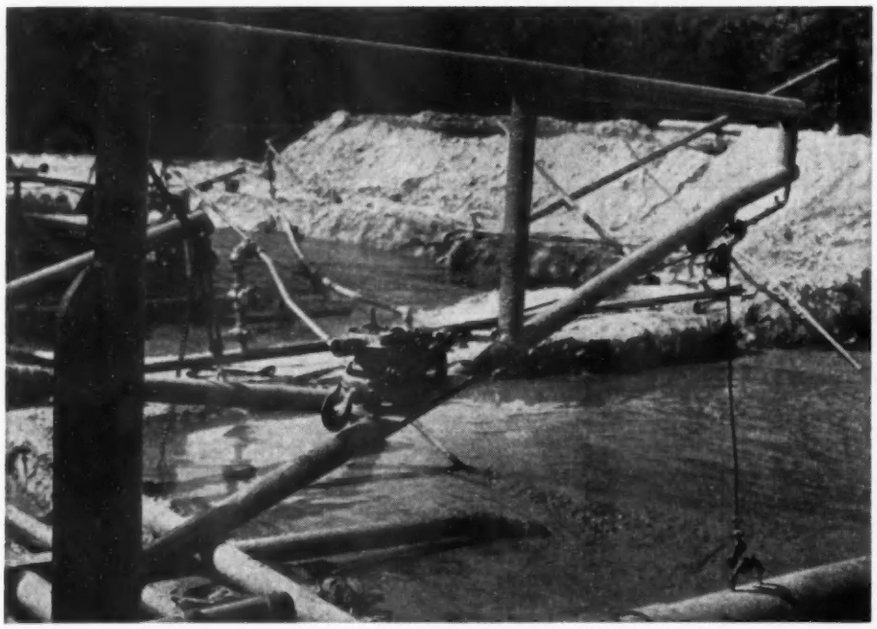
Stepped-up drilling rates are fairly well spread throughout the U. S., with most of the leading states on the increase. One of the leading gains occurred in Louisiana, where active rigs now number 414, while a year ago only 272 were working, and wells this year topped last year's by almost 16 percent.

The largest share of Louisiana's increase has taken place in the southern half, where deep drilling is the rule rather than exception. Latest count showed 319 rigs at work, and of those, 152 were drilling below 10,000 feet. One was below the 19,000-foot mark, and two had reached 17,000. Four were making hole just below 16,000, and a like number had arrived at the 15,000-foot level. An even dozen were pushing below 14,000, and the remaining 129 big rigs were drilling between 10,000 and 14,000 feet. South Louisiana is truly the home of the deep ones.

Texas, No. 1 in U. S. drilling volume, was the locale for 1339 active rigs at the end of August, compared with 1227 a year earlier. Texas' wells, in eight months, were up almost 6 percent over last year's.

Kansas and Nebraska have seen increased activity recently, and both have provided substantially more wells this year.

Colorado leads the way in the mountains, while Montana and Wyoming have failed to keep last year's pace.



Good drilling fluids don't just happen! Serving as the media for delivering valuable information to the surface for geological inspection, an efficient drilling fluid represents top quality application of chemistry, engineering and area know-how.

Why Geologists Should Know About Mud in Rotary Drilling

Reliability of the information furnished by cuttings, cores, mud analysis, and electrical logs is dependent upon the properties of the mud.

By DR. GEORGE R. GRAY
Baroid Sales Division, National Lead Company, Houston

THERE ARE many reasons why the geologist should know something about drilling mud. Some geologists make their living directly from drilling mud by locating clays and barite, and directing the exploration of the deposits. These mud materials are used in large quantities in oil-well drilling. Over 500,000 tons of bentonite, nearly 200,000 tons of other clays, and over 900,000 tons of barite are used annually in drilling muds. Many men with college training in geology are working as mud engineers and supervising the treatment of muds at drilling wells.

Although relatively few geologists owe their livelihood directly to drilling mud, many are dependent on the oil-producing industry and it in turn is dependent on the finding of oil and gas through drilling holes in the earth. In rotary drilled wells mud is the vehicle that brings to the surface information about the strata penetrated by the bit. Many holes are dry but the geologist can gain information from a dry hole that helps avoid drilling other dry holes. It is to the advantage of the geologist to make certain that the drilling mud is the one that best satisfies all the requirements placed upon it.

Drilling Fluid Functions. One of the primary functions of the drilling mud is to remove cuttings from the hole. How well this function is performed depends on pump capacity as well as on mud properties. If the velocity in the annulus between the wall of the hole and the drill pipe is low, the viscosity of the mud must be raised to remove the cuttings. The mud must also suspends the cuttings when circulation is interrupted. Viscosity and gel-forming properties of the mud usually depend on the quantity and condition of the colloidal clays in the mud.

A second important function of the drilling mud is to prevent the entry of formation fluids into the well. The flow of gas, oil, or salt water into the hole is prevented by maintaining the hydrostatic pressure of the mud column in excess of the fluid pressure in the formation. The weight (density) of the mud is increased by adding high specific gravity solids such as barite. Gel strength and gel rate also are properties that must be controlled in weighted muds. Serious reduction in hydrostatic head may be caused by withdrawing drill pipe from a hole filled with thick, gelled mud.

Another function of the drilling fluid that is of concern to the geologist is the sealing of the porous formations. If the openings in the permeable formation are of such diameter as to allow the whole mud to enter, loss of circulation occurs. Particles that are large enough to bridge the openings may be added to the mud, or a specially compounded slurry that will set up to a plastic or cemented mass may be pumped into the hole. If the openings in the permeable rock are too small for the mud solids to enter, these solids are filtered out and form a filter cake. In this case only the liquid from the mud enters the formation pores. The quantity of liquid that filters out of the mud is dependent on the permeability of the mud cake and not on the permeability of the formation. The extent of invasion and the thickness of the deposited cake are both of importance to the geologist. Filtration properties are dependent mainly on the colloidal materials in the mud and on the state of dispersion of these colloids.

The mud is expected to hold gravel and loose sand in place and to prevent caving of shales. The number of strings of casing that must be set to protect such formations is decreased by using good mud. The mud serves also to reduce corrosion and to lubricate and cool the bit and drill string.

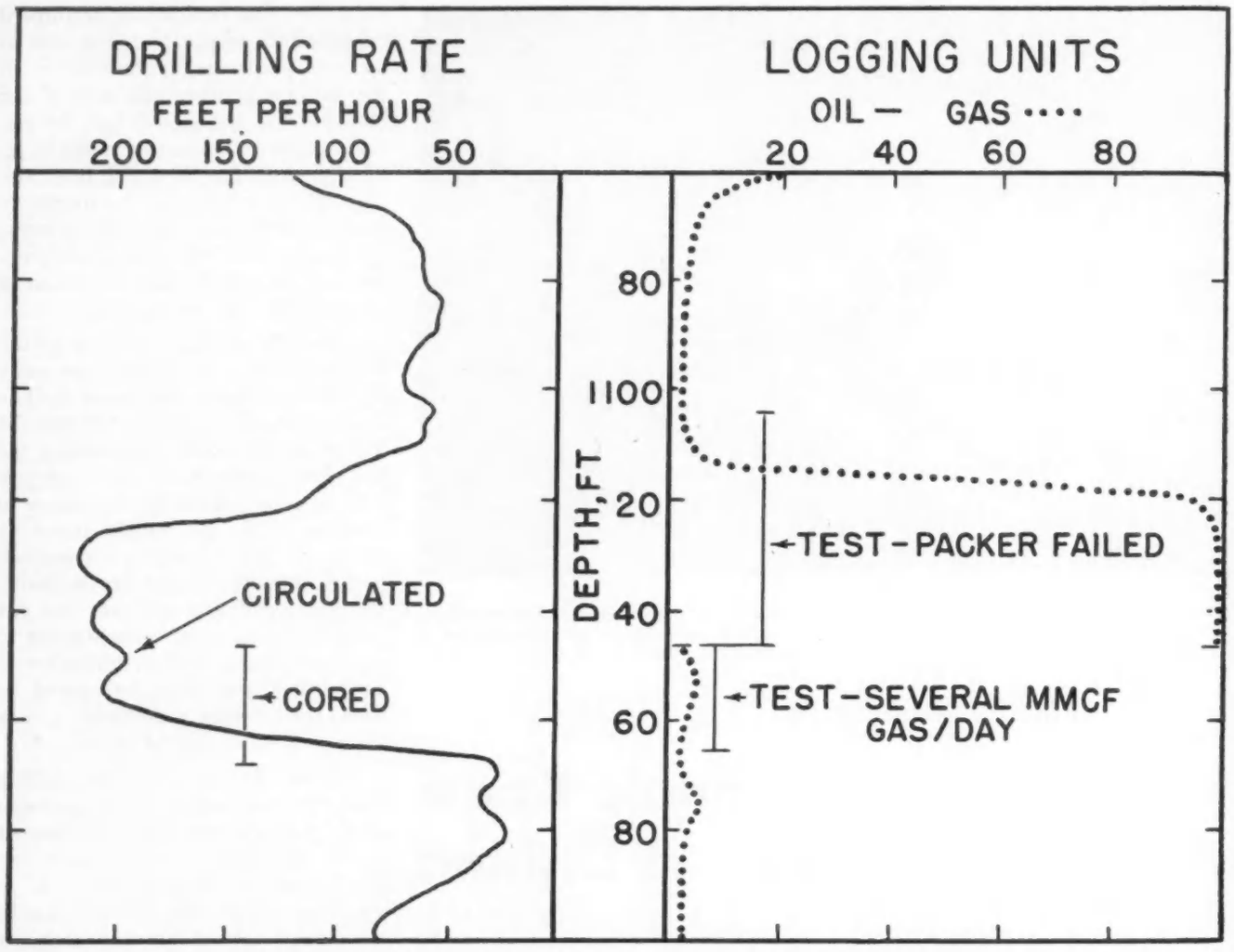


FIGURE 1—Mud log shows effect of flushing of gas by mud filtrate ahead of the bit.

Some negative requirements are placed on the mud. The mud should not retard the rate of drilling. Cores and cuttings should not be altered or flushed to an extent that makes it impossible to estimate the original fluid content. The mud serves as the medium in which the electrical surveys are made and should not interfere with the logging operation nor cause the curves to be altered in such way as to confuse the interpretation. Production from the completed well should not be adversely affected. Further, the mud should not be injurious to the drilling crew or hazardous to persons or property. Finally, the cost must not be excessive.

It is obvious that a great many demands, often conflicting, are made on the drilling fluid. Compromises must be made to effect some balance between contradictory requirements. The geologist should recognize these limitations and work with the drilling engineer in devising a mud program that best satisfies all the demands.

MUD PERFORMANCE OF CONCERN TO GEOLOGIST

Recovery of Cuttings. While drilling is in progress, the geologist is dependent on cuttings or mud analysis logging for information on the nature of the rocks being penetrated. Loss of circulation, or lost returns, usually can be overcome by treating the mud with bridging or plugging materials such as the fibrous, flake or granular products, or by plugging the formation with specially compounded cement or cement-like materials. In some cases none of these treatments is effective and casing must be set.

Sometimes even with full circulation few, if any cuttings, are recovered because they become dispersed in the mud as they travel to the surface. Cuttings may accumulate in washed-out sections of the hole and fall back into the mud stream from time to time and then be carried out of the hole. Rounded cuttings give evidence of inadequate carrying capacity. Carrying capacity is raised by increasing the rate of circulation and by raising the viscosity of the mud. Bentonite is commonly used to thicken the mud, although other clays, gelatinized starch, or carboxymethylcellulose (CMC) may be used, depending upon the composition of the mud in use. Enlargement of the hole can be held to a minimum by adhering to sound drilling practices and by maintaining good mud properties.

Flushing of Samples. Fluids originally in the rock drilled are partially displaced by the flushing action of the mud filtrate. Flushing takes place ahead of the bit and also after the chip or core has been cut. Flushing ahead of the bit is dependent mainly on the permeability of the rock and the viscosity of the mud filtrate. Filter cake is removed continuously from the bottom of the hole by the cutting action of the bit. As soon as the core passes into the barrel, a filter cake is deposited and the entry of mud filtrate into the porous rock becomes dependent on the permeability of the filter

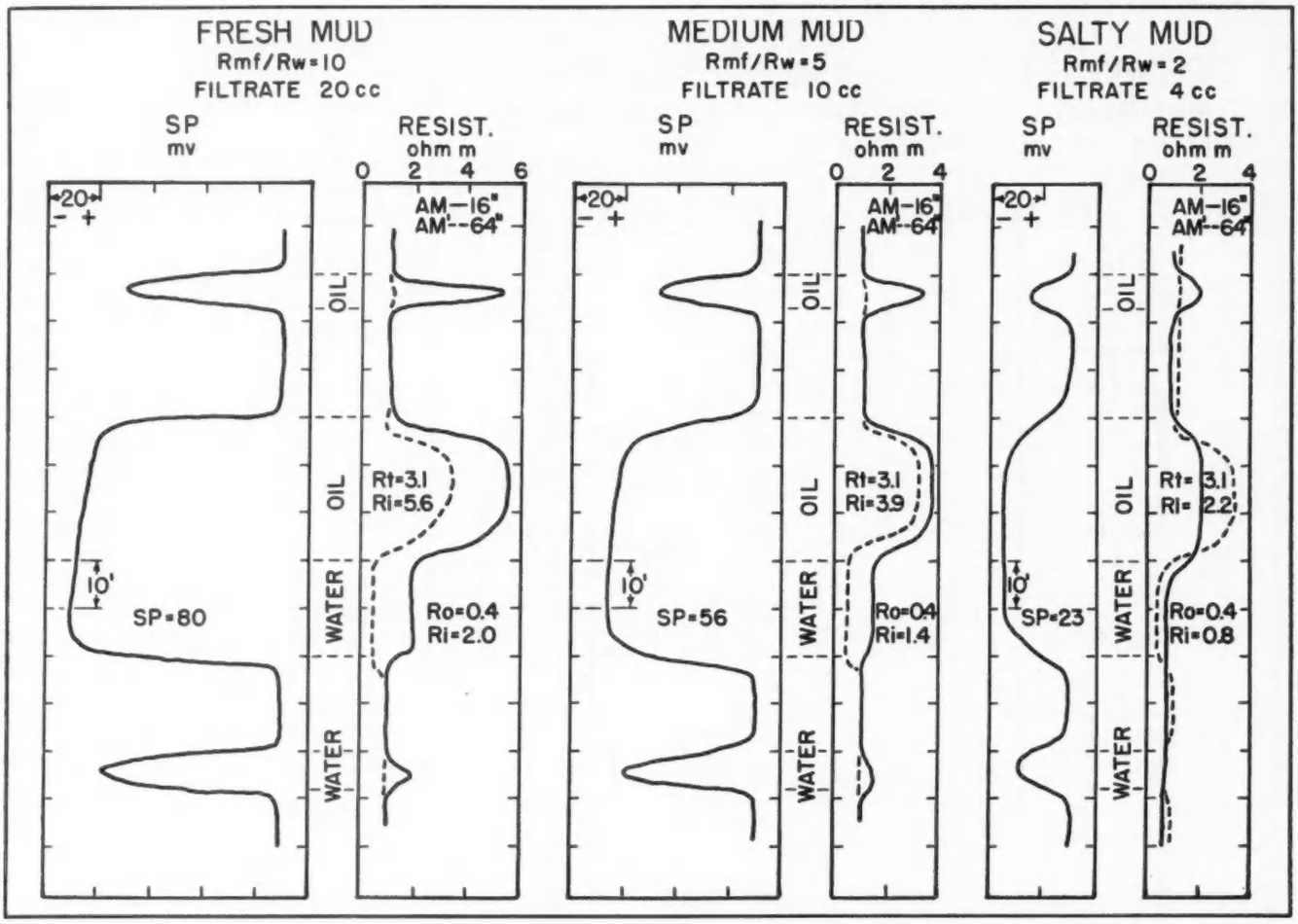


FIGURE 2—Influence of drilling mud properties on SP and resistivity logs (After R. P. Alger).

cake. This portion of the flushing can be regulated by treatment of the drilling fluid. As the core or chip is brought to the surface, the reduction in pressure allows the gas in the pores to expand, pushing out the liquids. This portion of the flushing can not be controlled.

Mud Logging. Mud logging (i.e., analysis of mud and cuttings for gas and oil) may be affected by mud properties. High-filtration mud may cause such extensive flushing as to reduce the shows. An excessive mud weight which produces a high differential in pressure between the mud column and the formation is undesirable. Mud properties may be such as to cause disintegration of cuttings, or, as already discussed, the cuttings may not be transported readily to the surface where they can be collected and properly related to the depth from which they came.

The effect of flushing on gas shows in the mud is illustrated in Figure 1, which is a portion of a mud log of a California well.

After a gas show, an attempt was made to make a drill-stem test but difficulties in setting the packer delayed the test for several days. A high-filtration mud was in the hole. When a core was cut, very little gas was found in the drilling mud because of water-flooding which had occurred ahead of the bit, although a drill-stem test produced at the rate of several million cubic feet of gas per day.

Stable oil-in-water emulsion muds do not interfere with the analysis of mud and cuttings for oil and gas, but unstable emulsions may cause difficulty. A refined oil, such as diesel oil, is preferred because the fluorescence of even a weathered crude oil may mask the identification of crude oil from the formation being drilled.

Electrical Logging. The geologist's work in interpreting electrical logs is directly affected by the drilling fluid used in the well. The composition of the drilling mud, and especially the filtrate, affects both the potential and the resistivity curves.

The magnitude and sign of the SP depend on the soluble constituents of the mud. The electrochemical potential arises from the difference in ionic activities of the interstitial water in porous rocks and of the mud in the hole. If the activity of the water is higher than that of the mud (as is the usual case), the SP increases in negative value opposite permeable beds. As the activities become nearer the same, the SP becomes smaller, and when the activity of the mud exceeds that of the interstitial water (as is the case with mud saturated with salt), the SP shows positive deflection opposite permeable beds.

The effect of the resistivity of the mud filtrate on the SP curve is illustrated in Figure 2 (after R. P. Alger, Schlumberger Oil Well Surveying Corporation). These curves show the changes in the SP log of a sand formation having these properties: porosity, 30 percent; permeability, 400 md.; water saturation, 36 percent; water resistivity, 0.05 ohm meter at 175° F.

The resistivity of the mud filtrate is not always subject to control (e.g., in drilling salt beds the filtrate will be-

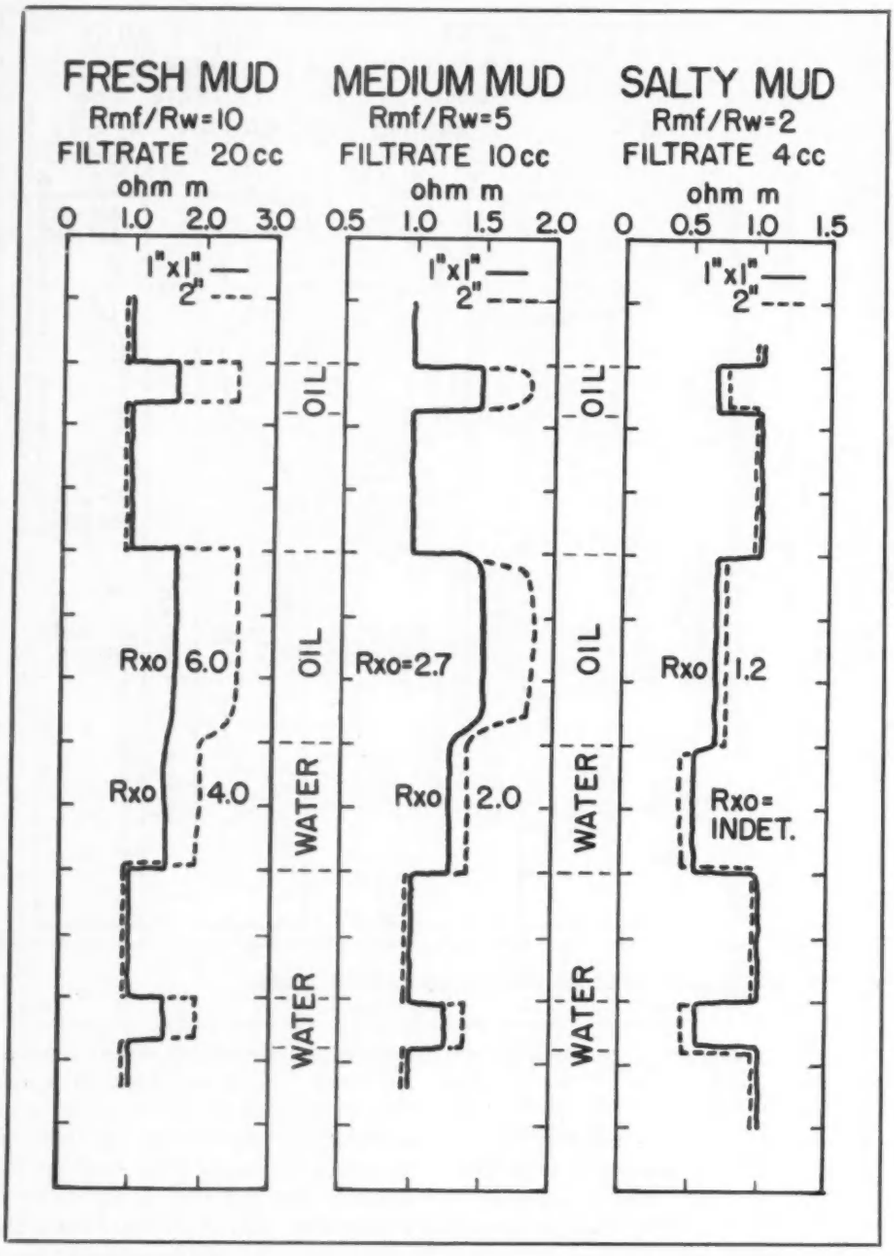


FIGURE 3—Influence of drilling mud properties on microlog (After R. P. Alger).

come saturated with salt). Often, however, considerable control of resistivity of the filtrate can be exercised by varying the chemical treatment given the mud. For example, by changing from a strongly alkaline lime-treated mud to a mud treated with much less caustic soda, resistivity of the mud was increased from 0.2 to 1.6 ohm meters at 100° F. and the SP was increased significantly.

Among the major factors influencing the resistivity logs are these involving the mud: resistivity of mud, resistivity of filtrate, and the diameter of the zone invaded by the mud filtrate.

The effect of mud filtrate on resistivity is illustrated in Figure 2.

Mention has already been made of the fact that the amount of filtrate that invades the permeable bed is dependent on the filtration properties of the mud under bore hole conditions of temperature and pressure, and depends on the permeability of the deposted filter cake and not on the permeability of the formation. Thus, for a formation of low porosity, the depth of invasion is greater than for a formation of high porosity. By controlling mud properties to reduce filtration to a minimum, the depth of invasion of tight sands can be reduced materially.

Interpretation of logs of the Eocene Wilcox of the Gulf Coast is complicated by the presence of lignite streaks, lignitic shales, and by invasion of the tight sands by mud filtrate. Significant improvement has been made in the quantitative evaluation of the electrical log by using mud of controlled resistivity and low filtration in conjunction with the focusing type of resistivity measurement. By maintaining the resistivity of the mud at about four times the resistivity of the interstitial water, the resistivity of the bed can be estimated reliably while the SP curve on an amplified scale is adequate. The reliability of the quantitative estimations based on the SP curve is improved by reducing the ratio of mud filtrate resistivity to interstitial water resistivity. Depth of filtrate invasion must be kept low by using low-filtration mud and by logging promptly after the formation of interest has been drilled.

Low-filtration mud and prompt logging are also very desirable factors for satisfactory induction logs. The resistivity of the filtrate should be more than ten times that of the interstitial water and the resistivity of the oil-bearing sand should be less than thirty times that of the mud.

Resistivity logging by contact devices depends on the formation of a filter cake on the permeable formation. Mud properties affect the contact log, as may be seen in Figure 3, which illustrates the same formations as in Figure 2.

When oil-base mud is used, no SP curve is developed, and information on properties of the formations must be gained from the gamma ray, neutron and induction logs. The resistivity of the beds can be determined reliably from the induction log but the resistivity of the interstitial water cannot be determined in oil-base mud.

Conclusion. The petroleum geologist should be concerned with the drilling fluid because it is the means through which he gains information about conditions in the well bore. Reliability of the information furnished by cuttings, cores, mud analysis, and electrical logs, is dependent on the properties of the mud. Cooperation of the geologist with the mud engineer in planning the mud program will make the work of both easier and chances for successful completions greater.

ACKNOWLEDGMENT

This article was presented as a paper at the Mississippi Geological Society meeting, March 3, 1955, and at the Tulsa Geological Society, April 15, 1955.

—The End

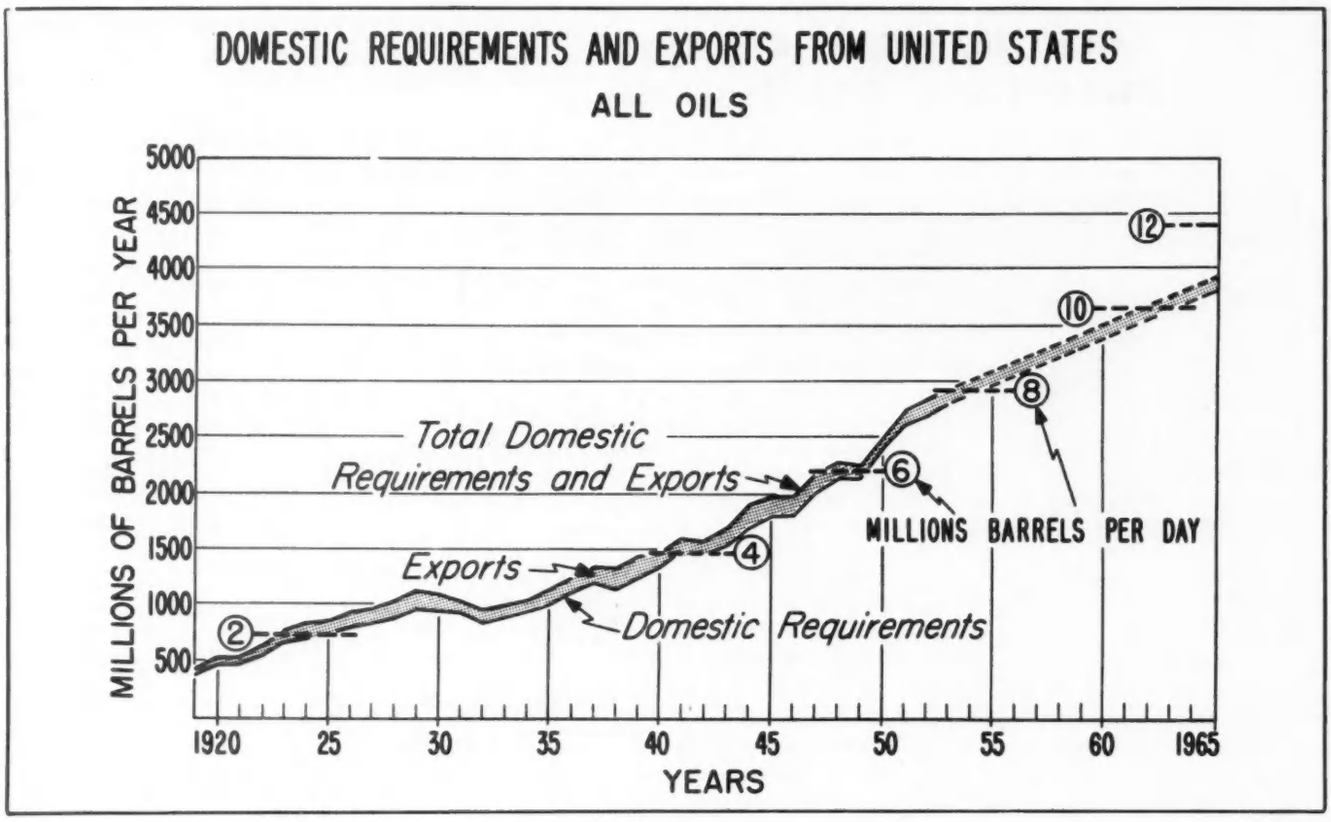


FIGURE 1

Exploration Men Must Work Hard and Well to Find Needed Oil

The Future . . . ?

- Petroleum demand greater.
- Fields progressively harder to find.
- Geologists and geophysicists must improve present oil finding methods and develop new ones.

By HAROLD T. MORLEY, Stanolind Oil and Gas Company, Tulsa

IT WAS NOT too many years ago that professional geologists were few and far between in the oil industry. In the early 1900's for example men with geologic training could find employment only with mining companies, or with a selected few state of federal agencies, or as teachers of the subject on college faculties. Later on, however, as oil men began to appreciate better the nature of petroleum and the circumstances of its deposition within the earth's crust, they began to look to geologists for advice and guidance. And the specialized field of petroleum geology got its start.

There is no question of its status today. The American Association of Petroleum Geologists has more than 11,000 members. Scarcely an oil company, large or small, is without geologists on its staff, or does not engage the services of consulting geologists. The heads of several large and well known companies are geologists who have risen through the ranks. These facts are indeed eloquent testimony to the success and the achievements of the profession.

The growth in stature of petroleum geology has paralleled the growth of the American oil industry, as well as making a substantial contribution to it. Figure 1 shows the rate of crude oil production since 1919 in terms of demand for petroleum products. During 1954 the oil industry had to produce 2½ billion barrels, or more than 7 million per day, to supply a demand that has multiplied five times in the course of 34 years. This curve is extended conservatively and indicates

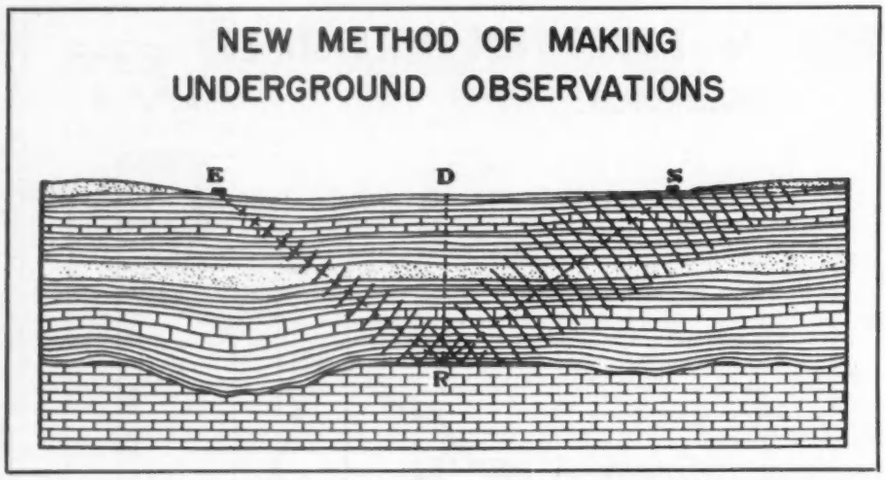


FIGURE 2—(J. A. Udden Bulletin AAPG, Vol. 4, No. 1, 1920)

that close to 11 million barrels per day will be required by 1965.

At present there is an oversupply of oil brought about largely by an inadequate market for foreign oil. As economic conditions and living standards improve in other countries—a present-day trend that is being stimulated by the country's many aid programs abroad—demand for oil worldwide will increase and the domestic industry will be called upon to supply most of the domestic needs for many years to come.

The future? In the face of this projected demand, and the fact that new fields are progressively harder to find, it is evident that the most important developments in the usefulness of petroleum geology are still to come. It is equally evident that some hard geologic thinking must be done if the science of petroleum geology is to continue its history of service to the industry and to the American people.

Even though oil is plentiful now, it would appear that we have come to some sort of plateau in our upward path of oil-finding by the methods that have prevailed for the past 25 years. It seems apparent that in most of the active oil provinces, undrilled seismic structures are more scarce and smaller in size, and the law of diminishing returns seem to be operating. Yet there is every reason to be confident that large reserves of undiscovered oil and gas exist in stratigraphic change-of-facies type reservoirs. Since many of these reservoirs are at great depths, some new method of pin-pointing a location for a stratigraphic-trap test will need to be found that will make it possible to drill expensive deep wells with not more than the usual risk.

The problem of greatly improving known methods of oil-finding or developing entirely new ones also existed in the 1920's. It didn't take long, even in the early days of the geological profession with one-tenth the number of geologists active today, for field geologists to map and re-map most of the structures in the areas of good surface outcrops in what were considered the best oil provinces. The areas of good surface outcrops represented only a small part of the potential oil-producing territory, and so vast areas were left for core drill, magnetic and gravity exploration. These methods were inadequate and were only partially filling the bill.

The prospects of successfully exploring these areas seemed so meager that the prevalence of opinion was to the effect that oil production would be exhausted by the early 1930's, and that refining of oil shale was our only hope.

Geologic papers in the 1920's contained such phrases as: "The inevitable decrease in the total yearly production of petroleum in the U. S.," and "Experts who have made a close study of the situation predict that within the next 2 to 5 years the production of crude oil from American oil fields will start to decline and from that time on we will have a smaller yield each year."

Even in more recent years oil economists hesitated to predict increasing yearly production beyond five years before the expected decline was to start. Federal spokesmen were even more concerned, to the extent that they were advocating government construction and operation of commercial-scale plants for refining oil shale, and for converting coal into liquid fuels. These projects, unnecessary as they were, finally were tabled, but had they gone through, the cost to the taxpayers would have been fantastic and the results not nearly in keeping with the expenditures.

Advent of seismograph. It was in such an atmosphere of pessimism in the 1920's that the seismograph made its appearance and changed much of the thinking with respect to oil finding. Figure 2 is interesting because it was published three years before refraction seismographs appeared on the Gulf Coast and seven years before the first reflection seismograph was used in Oklahoma.

Dr. J. A. Udden, then director of the Bureau of Economic Geology of Texas, wrote an article entitled "Suggestions of a New Method of Making Underground Observations." His article was printed in Volume 4, No. 1 of the AAPG Bulletin of 1920. In it he said in part:

"It has suggested itself to the writer that it ought to be possible, with present refinements in physical apparatus and their use, to construct an instrument that would record the reflections of earth waves started at the surface, as they encounter such a well-marked plane of difference in hardness and elasticity as that separating the Bend and Ellenburger formations . . . 'possibly a slight adaptation of some of the present seismograph.' A seismic wave might be started by an explosion at the surface of the earth, and a record of the emerged reflection of this wave from the upper surface of the Ellenburger limestone might be registered on an instrument placed at some distance from the explosion."

The Ellenburger was known to be an unconformity surface, and prospecting for it in the Ranger-Desdemona field had reached the random drilling stage. It called for some new method, and Dr. Udden rose to the occasion. Apparently he did not realize 35 years ago the far-reaching effects his suggestion would have—the formation of an entirely new industry and the discovery of new billions of barrels of oil.

Yet even with vastly improved instruments and techniques, other methods in addition to seismic will be needed to find the large undiscovered reserves that can be confidently ex-

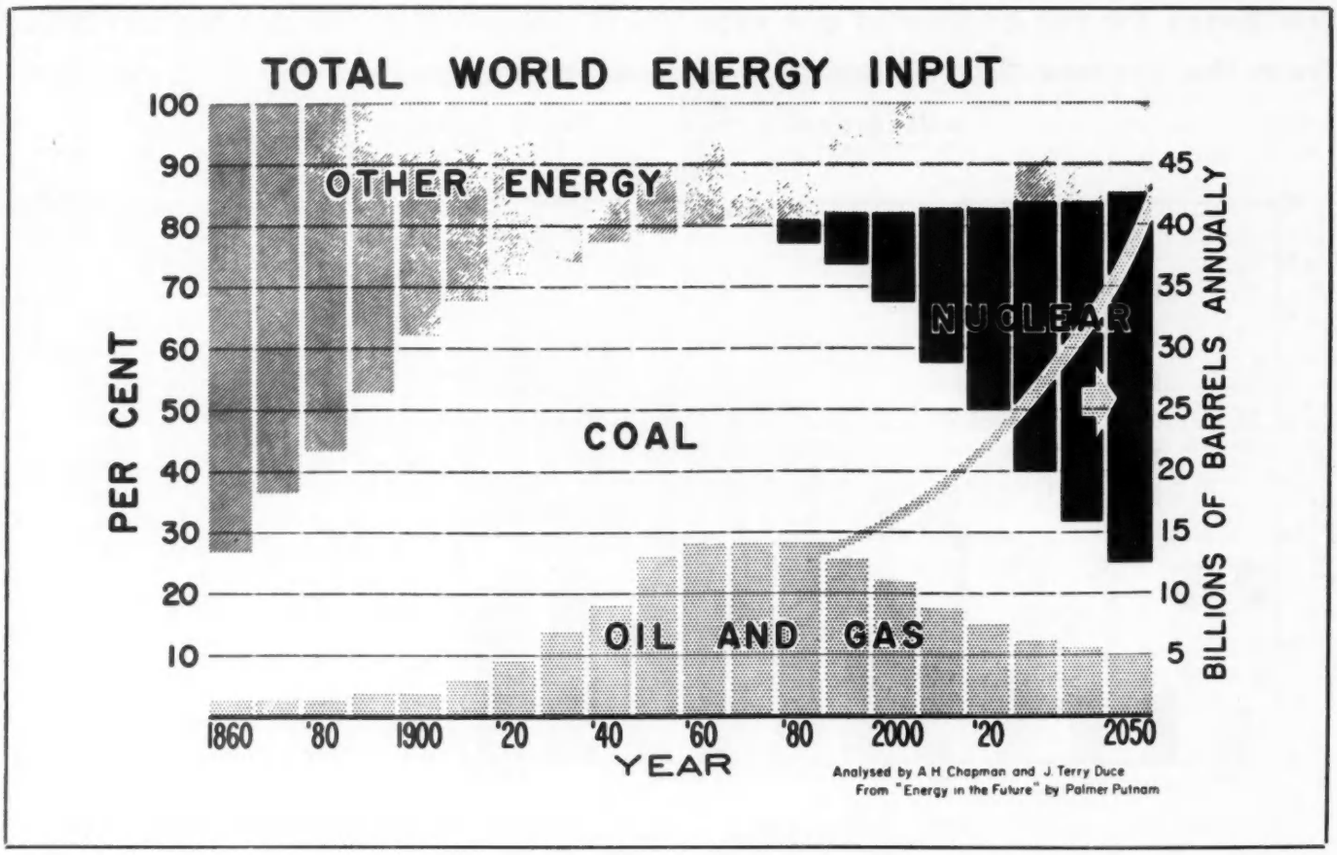


FIGURE 3

pected to exist in many gradational provinces, and at great depths beneath repeated unconformities in complex structures.

John Suman, who retired in 1954 from Standard Oil Company (New Jersey), has said that as much oil as has already been found in the U. S.—that is, another 50 billion barrels—will be discovered in the future. His statement is typical of the almost universal opinion that the oil is there. It is certain the demand for that oil will be there, too.

Enter atomic energy. There is considerable speculation these days surrounding the advent of atomic energy, and what its effect will be on the petroleum industry. It is a question that affects oil geologists. The following comments on the subject are a brief summary of parts of a study made at Stanolind's research center.

Central power generation plants appear to be the only competition for petroleum within the foreseeable future, and this type of energy competition represents only about three percent of crude oil production, all of it in the form of residual fuels. Many major suppliers of power for electricity are working on plans for nuclear power systems. It is possible that within 15 or 20 years nuclear power plants will generate economical power. Presently, without the advantage of government subsidy, such plants are not considered economic. When they become so, it is likely that they will be built to supplement existing conventional facilities, rather than displacing them.

Rapidly expanding requirements for electric power throughout the nation is one reason existing facilities will not be displaced; the tremendous financial investment in present facilities is a second one.

Nuclear power reactors are basically simple, but they become very complex structures in view of the many problems involved. These call for the design of elaborate shields and control systems for processing hazardous material, and eliminating air and water pollution from radioactive waste.

As for land vehicles, the weight of shielding is a serious handicap, and the solution of this problem has been said to be in the same class with the problem of shielding against gravity. Until this problem of shielding can be disposed of, the hazards of handling nuclear materials make it extremely unlikely that nuclear-powered vehicles can compete with today's efficient gasoline-driven automobiles.

Nuclear power has definite advantages for submarines and is apparently successful in the Nautilus. Several incentives exist in the case of submarines, however, that do not apply to other types of mobile units. For one thing, the fact that costs are competitive is unimportant because a submarine is a defense weapon and therefore a government project. Secondly, the advantages of very infrequent refueling, long submergence periods by virtue of the fact that no oxygen is required for the engines, and the absence of tell-tale exhaust trail from the wake render this type of power particularly desirable for these vessels. Other ocean-going ships can probably employ nuclear reactor systems to good advantage. But again, competitive costs probably rule out their use for other than warships, unless we resort to the dangerous expedient of government subsidy.

So it would appear that the petroleum industry will not be faced with a competitive challenge from atomic energy for 15 to 20 years. By that

The bases for the estimates are that world population will double by 2050 from the present 2½ billion to 5 billion people, and energy requirements will increase annually by 3 percent.

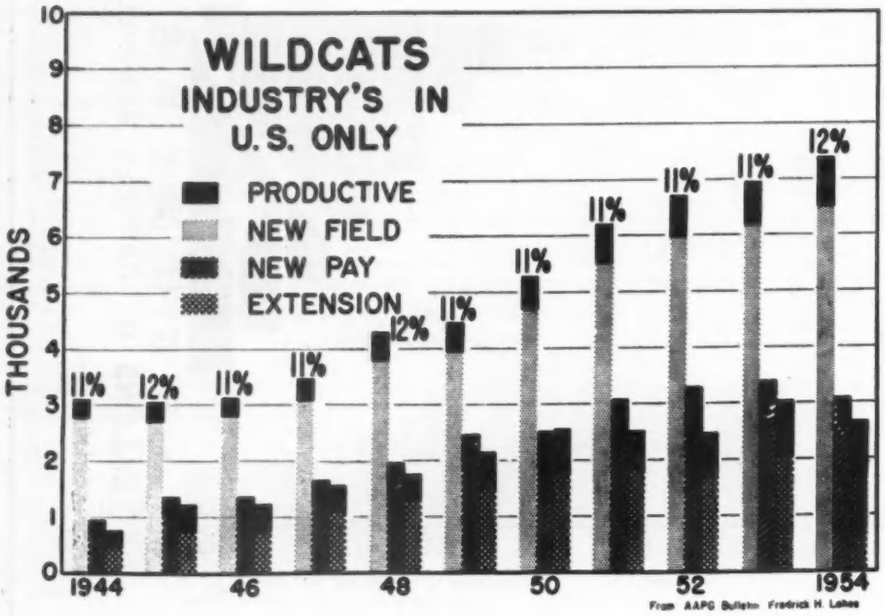


FIGURE 4

time, it will probably be needed to supplement the nation's ever-increasing energy requirements.

Future needs. What these future energy requirements will be has recently been considered in a comprehensive study made for the Atomic Energy Commission (Figure 3).

In a feature article in the March, 1955, issue of the *Journal of Technology*, A. H. Chapman and J. Terry Duce used figures from "Energy in the Future," by Palmer Putnam, which book was developed from the AEC study, to construct Figure 3. It looks into the crystal ball for the next century. These figures are percentages, and since the demand for energy is expected to exceed present demand several times over by the year 2050, and 10 percent of energy requirements that hydrocarbon fuels are estimated to provide in 2050 is a much greater figure in actual volume than the 27 percent figure which hydrocarbon fuels account for today.

The bases for the estimates are that world population will double by 2050 from the present 2½ billion to 5 billion people, and energy requirements will increase annually by 3 percent.

It is evident from these figures that the petroleum industry will continue to play a major part in the nation's and the world's economy for many years to come—if it can continue to find new reserves of oil and gas. That province is largely the responsibility of the petroleum geologists, and it will present a real challenge to their ingenuity and imagination.

Research, of course, is adding continually to our fund of knowledge. What is needed most, and what could be the next revolutionary phase of our exploration climb, is a new drilling method. Progress is being made in ideas on other means of drilling quicker, cheaper and deeper. What a stimulating effect a new cheap drilling method could have on rapid new discovery and development is perhaps best being illustrated today by the scope of activity in the Colorado Julesburg Basin.

Cheaper drilling means more drilling, and more drilling usually means more oil. This statement is best illustrated by Figures 4 and 5, constructed from Lahee's reports which show that for the past 10 years the percentage of wildcat discoveries remains the same as total wildcats increase. Some of the ideas of radical departures in drilling methods, such as vibration or sonic, may not be more fantastic than the thought of recording sound waves was 35 years ago.

Interest is increasing among geologists in closer studies of sedimentation.

The subsurface geologist is adding to his repertoire the ability to recognize more accurately from cores and samples the history of the rock and how it was laid down. Laboratory analyses are faster, more precise and more quantitatively correct, and they allow for closer studies of origin.

Electric well logging is constantly being improved and additions made to the number of formation characteristics which can be measured electrically. This information can be invaluable in replacing core information where it is not available. Skill in electric log interpretation is an ever-increasing requirement of the present-day petroleum geologist.

More attention is being paid to microfossils and the demand for pale-

About the Author

H. T. MORLEY, chief geologist for Stanolind Oil and Gas Company, has been with Stanolind and its predecessor companies, Midwest Refining and Midwest Exploration, since 1919. At the formation of Stanolind in 1931, Morley was first made district geologist for the company in Amarillo, Texas, later becoming division exploration manager in Fort Worth. In January, 1932, he became chief geologist, headquartered in the company's general office in Tulsa. Morley, a native of Denver, graduated from the University of Colorado with a BA degree in geology. A veteran of World War I, he is a member of the AAPG and the Tulsa Geological Society.

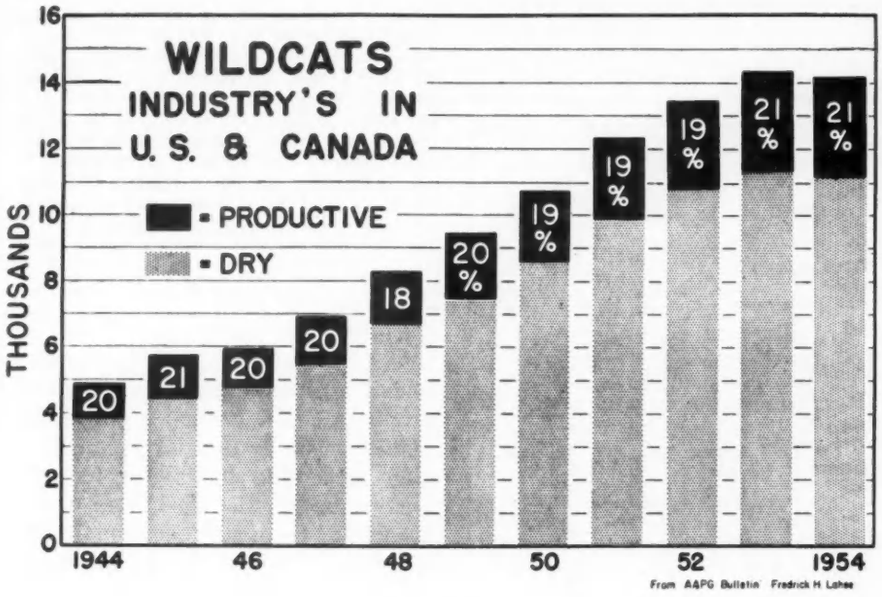


FIGURE 5

ontologists is increasing. Studies of deposits in present ocean basins are adding to our knowledge of rock formations. These studies include the chemistry of calcium and magnesium carbonates to better understand limestone sedimentation and dolomitization.

Most of these studies are being made in research laboratories, but they will need to be in common usage by all geologists as time goes on. The geologist of tomorrow will need to develop broader horizons in his thinking; he will need to be familiar with and able to make use of all the techniques that have been developed, and all those that will be developed, if he is to succeed in his assignment of unlocking more of the earth's mysteries.

The seimograph will continue to be an exploratory tool for many years. It is a geologic tool, but any tendency to use it as a replacement for geologic thinking should no longer exist. Seismologists are continually working on improvements in this highly valuable technique. They will need to continue and even intensify their efforts, in order to find criteria in their records that will map facies changes and thus make their science an even more valuable asset than it already is. More and more, it is necessary that geology be an important part of the seismologist's training, and seismology an equally important part of the geologist's training.

Youth vital. Our most important assets are our younger geologists. Geological ability is more in demand in the petroleum industry than ever. Everything must be done to attract the best quality of personnel into the geological profession to assure the industry of a continuing supply of fresh geological talent.

There is one other responsibility that falls within the province of the petroleum geologist.

The public has always taken pretty much for granted that a plentiful supply of petroleum products has been available as needed. Aside from war-provoked emergencies or temporary spot shortages caused by lack of transportation facilities, there has never been any real cause for concern over this nation's oil supplies. Similarly, there has never been any real understanding of the oil industry and its peculiar problems, or of the importance of a free competitive atmosphere to its continued success.

Some measure of the part the profit incentive and freedom of individual action have played is the fact that the U. S., with only 5 percent of the total land area of the earth, has provided more than 50 percent of all the oil produced up to this time. That is more than 20 times more oil than the rest of the world on the basis of unit area.

Certainly this has not been true because we had greater reserves than other countries. Nor has the excellence of our scientific advancement been solely responsible. The answer lies chiefly in the fact that our free competitive system provided far greater incentives to discover and develop these reserves than are offered by socialistic ideologies of government ownership. If the supply of oil and gas is to continue to increase in this country, the public will need to understand this and vote to reverse our socialistic trends.

The present situation surrounding natural gas is an indication of the problems we are sure to face in the future. For almost a year now, production and gathering of natural gas have been under the jurisdiction of the Federal Power Commission. Efforts being made in Congress now to amend the Natural Gas Act, and thus to free producers and gatherers from federal regulation, are being met with strong organized opposition, principally from consumer groups who have no understanding of the petroleum business, and who cannot comprehend why natural gas production cannot be made a public utility.

If these efforts to amend the act are not successful, there can be little doubt that such controls will be extended eventually to crude oil. Nationalization of the oil and gas industry will then have been achieved. We are all too familiar with the history of the Mexican oil industry after nationalization to need to predict what will happen to the domestic oil industry if it is nationalized.

Geologists, who are in an excellent position both to appraise the risk element in oil and gas production and to appreciate the contribution that a free system has made to the industry's success, should be in the vanguard of those who are working to free natural gas production from the yoke of federal controls.

The one further responsibility of the petroleum geologist, then, is to become a qualified spokesman for his industry. Technical proficiency is no longer enough; the geologist must join with other technical and nontechnical people in getting the oil and gas industry's story across to the public. Any effort short of a total effort will not be enough.

ACKNOWLEDGMENT

The above was presented as the retiring president's address at the annual meeting of the Tulsa Geological Society, Tulsa.

—The End

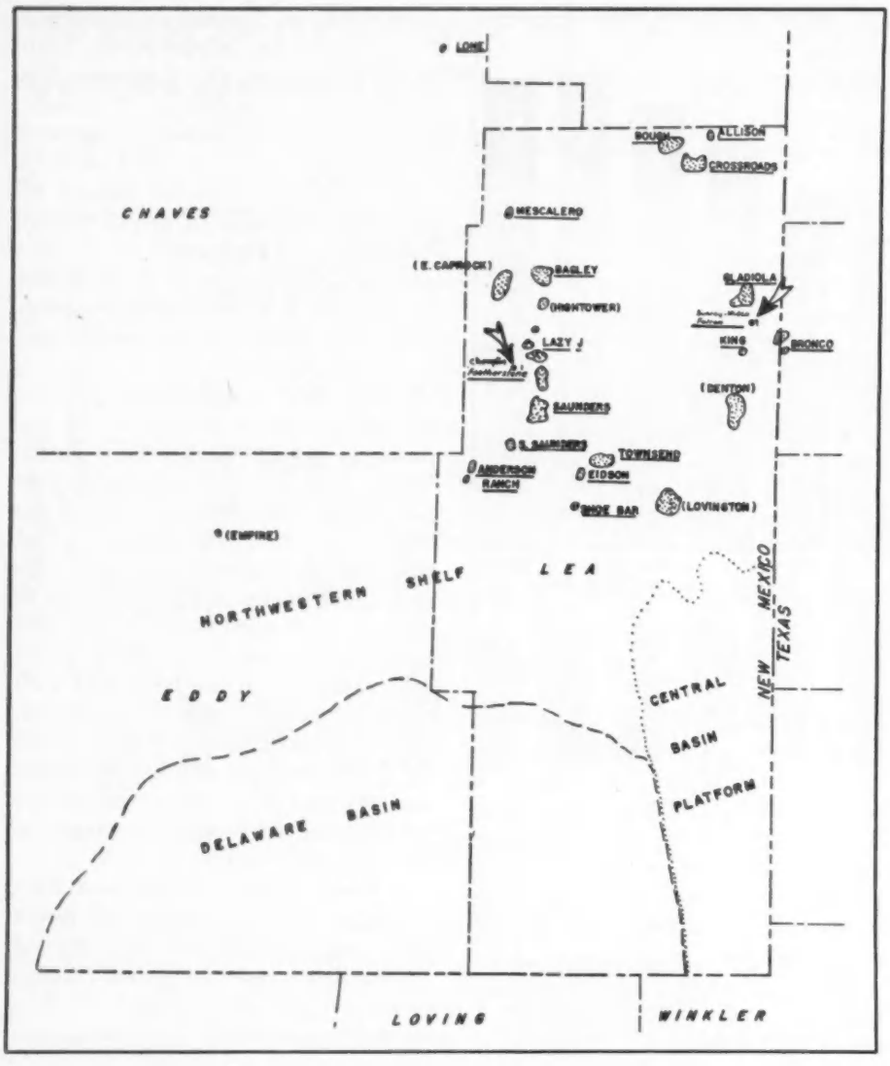


FIGURE 1—Fields having Wolfcamp production, Southeastern New Mexico. Fields having Hueco production are in parenthesis. Fields having Bursum production are underscored. Champlin Featherstone-Federal, Sec. 6-14S-33E, completed 5-2-55, I.P.F. 207 BOPD 23/64 choke, field name applied for: Baum Wolfcamp. Sunray-Mid-Continent, O. E. Fulton 1, Sec. 6-13S-38-E, completed 7-24-55, I.P.F. 943 BOPD ½-inch choke, field name applied for: South Gladiola Wolfcamp.

Lower Wolfcamp Important Pay in New Mexico

. . . If wider well spacing is used.

By S. G. HARDISON, District Geologist,
Kerr-McGee Oil Industries, Inc., Amarillo

RECENT NEW OIL discoveries in the Lower Wolfcamp in the Northwestern Shelf area of Southeastern New Mexico are reviving interest in this important producing horizon. Production in this zone was first obtained by Magnolia Petroleum Company's Betenbaugh 1 in April, 1949.

Although discovery and development have been continuous since then, activity has been slow, due largely to the reluctance of operators to drill for this horizon as an objective, as it averages about 9800 feet in depth, and the thin carbonate pay section averages 25 feet.

Recent developments, as shown in Figure 1, nevertheless have caused a revival of interest in Lower Wolfcamp production. The horizon is potentially important for future development. A large area offers possibilities for production from the zone, and many more fields yielding production from it undoubtedly will be found. Although this pay has lacked attractiveness because of its depth and limited thickness, it offers possibilities of satisfactory return on investment, particularly if wider well spacing is employed.

Considerable ambiguity exists as to just what constitutes the Lower Wolfcamp in New Mexico. As an example, the pay in the Townsend field is officially listed as Wolfcamp, while the correlative pays in the Saunders and Baugh fields are officially listed as Pennsylvanian (Figure 2).

Other fields are simply listed as being Permo-Pennsylvanian. The writer has conducted detailed sample and stratigraphic studies with the aid of fusilinid identification and believes that most of the so-called Pennsylvanian and Permo-Pennsylvanian fields on the Shelf are Lower Wolfcamp (Bursum) in age. Although this is primarily a discussion of the Bursum, the Wolfcamp will be briefly discussed in its entirety.

Stratigraphy and Lithology. The Wolfcamp is present in part or in full section over the entire northwestern shelf area and over most of the Central basin platform of New Mexico. In the shelf area of Lea County, the Wolfcamp averages 1000 feet in thickness and on the basis of lithology and fusilinid age determination, is divided into two groups, the Hueco and the Bursum.

• **Hueco**—For purposes of discussion, the Hueco can be divided into three units (Figure 2).

The upper unit, averaging 200 feet in thickness, consists of more or less cherty fine crystalline dolomite and appears to be conformable with the

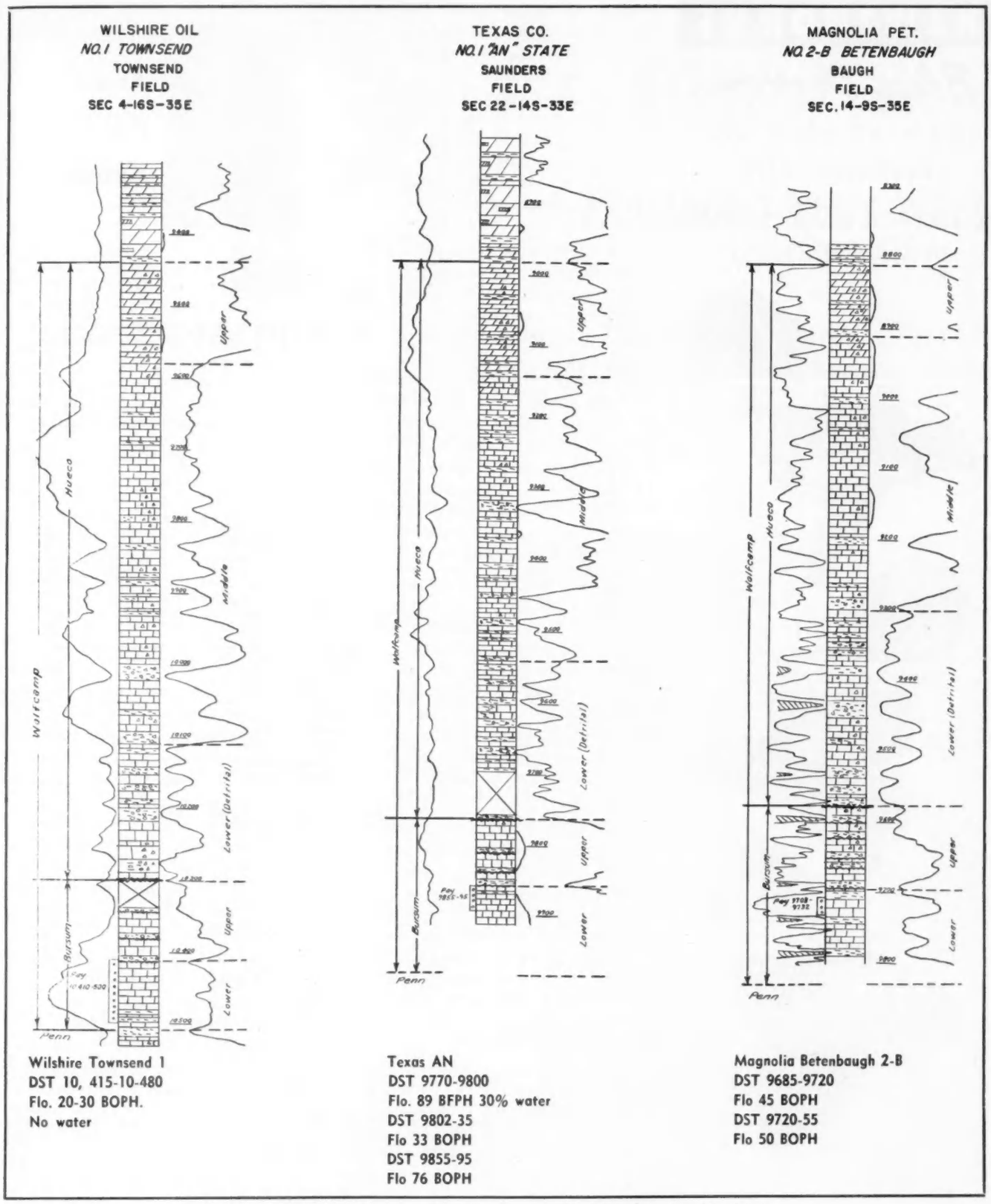


FIGURE 2—Typical Wolfcamp sections, Northwestern Shelf Area, Lea Co., New Mexico.

overlying Leonard (Permian) sediments.

The middle unit, averaging 300 feet, consists predominately of chalky limestone becoming dense and cherty at the base. Locally, the contact zone with the upper unit may be dolomatized, making the boundary difficult to delineate.

The lower unit, averaging 200 feet, is largely detrital in nature. It consists principally of soft red and green shales containing dark limestone and chert pebbles, interbedded with fine crystalline, chalky and detrital limestones.

These limestones are sometimes cherty and arkosic. The amount of

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detrital material increases toward the base of the unit.

• **Bursum**—The Bursum averages 300 feet in thickness and is apparently unconformable with the Hueco. It is present over most of the shelf area but is largely absent over the Central basin platform. For discussion purposes, the Bursum is divided into an upper and lower unit (Figure 2).

The upper unit averages 100 feet in thickness and is composed of alternating chalky, fine crystalline and dense limestone separated by relatively thin red and green detrital shales. Locally, the limestone may become cherty. The lower unit is lithologically similar, but the limestones are somewhat thicker and the shales lack the detrital pebbles of the upper unit and are usually gray in color. The lower unit appears to be conformable with the Pennsylvania.

Reservoir Development

• **Hueco**—Only one reservoir development of note occurs in the Hueco. This is found at the contact zone of the middle and upper units. Locally, porosity appears to have been developed in connection with dolomatization. Denton and Hightower are examples of fields producing from this horizon. Some oil has been recovered from limestone in the lower detrital unit of the Hueco, but is of little importance.

• **Bursum**—Widespread multiple reservoir development occurs within the Bursum. While the number is variable, the Saunders field is thought to have as many as five such reservoirs, each with individual gas—oil—water contacts. Some interesting conjectures can be drawn from the geological evidence at hand as to the origin of these multiple reservoirs.

The alternating limestone and detrital shale sequences of the upper unit of the Bursum is indicative of deposition during a period of instability. The absence of any large quantity of detrital shales and the deposition of "clean" limestones indicates alternating moderate regional up warpings with land masses at low relief, allowing for little erosion, followed by subsidence and deposition.

It is probable that circulating ground waters created porosity in the emergent land mass and that the thin mantle of detrital shale deposited after subsidence provided the "cap" for the reservoir.

Any topographic highs that existed along the sea floor would be subjected to greater erosion than surrounding land masses on emergence. The existence of these highs is indicated by thin detrital shales of the upper unit. The absence or thinning of pays across some of the fields on the shelf could be due to truncation rather than deposition.

A large, more diastrophic movement occurred at the end of Bursum times, elevating such features as the Central basin platform. The source for the large amounts of detrital material found in the lower unit of the Hueco was probably from erosion of pre-Hueco sediments from the Central basin platform and other areas to the north and west of the shelf.

Structure. Along the west side of the Northwestern shelf, the Mescalero-Caprock and Bagley-Saunders trends are the result of a series in echelon folds with the axis of folding north-south. Farther east in the Baugh-Gladiola area, the axis of folding has shifted to northwest-southeast.

Many of the Wolfcamp fields, such

About the Author

S. G. HARDISON was in the U. S. Navy from 1941 to 1945 attending the Navy V-12 program at the University of Texas. He entered S.M.U. in 1946 after a short period of seismograph work in Louisiana and received a B.S. degree in geology in 1948. After graduation he joined Kerr-McGee Oil Industries, Inc., and in 1950 became district geologist for the Panhandle area. In 1952 he was transferred to Midland, Texas, as district geologist for the West Texas-New Mexico division but returned to the Panhandle area in 1954 as district geologist and is now located at Amarillo, Texas.

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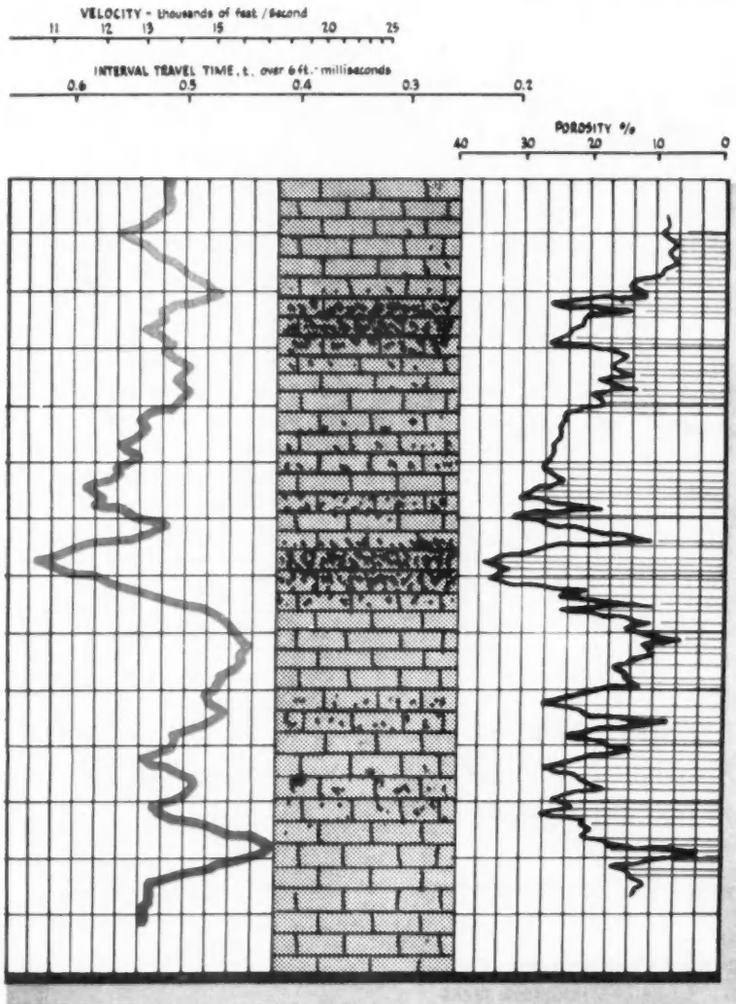
VELOCITY - thousands of feet / second
11 12 13 15 20 25
INTERVAL TRAVEL TIME, t, over 6 ft. - milliseconds
0.6 0.5 0.4 0.3 0.2
POROSITY %
40 30 20 10 0

The data shown here are the results of a test conducted by Magnolia Petroleum Company, to demonstrate the natural relationship between interval velocity and the porosity of a limestone.

For this test, a section of limestone was sampled for porosity, and the values recorded, *see curve on right.* An interval velocity log was then made of the same limestone section, *see curve on left.* Note the marked similarity of the two logs.

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as Gladiola, are associated with deep seated Devonian folds which are productive. Others, such as Baugh, apparently are not.

Closures on the producing horizon vary from 25 to 100 feet. However, in some fields such as Tulk, accumulation occurs due to truncation or porosity pinchout on structural noses.

Production History. At the present time, there are 17 fields producing from Bursum on the shelf (Figure 1). These fields have all been developed on 40-acre spacing, and are believed to be dissolved gas drive. The gravity of the oil ranges from 42 to 50 degrees with the gas/oil ratio averaging 1500 to 1. Initial bottom hole pressures run in the vicinity of 3500 pounds per square inch. In order to anticipate eventual recoveries from the Bursum, two fields are discussed briefly:

• **Saunders.** Discovered in January, 1952, there are at present 55 producing wells in the field, 20 on gas lift, 20 flowing, and 15 pumping. As of March 1, 1955, these wells had produced 6,993,690 barrels of oil or an average of 127,158 barrels per well. In terms of per acre/foot, this would be 127 barrels.

Many of the wells in the field have been on production for just a few years. Actually, there are over 17 wells in the field which have produced over 200,000 barrels each.

• **Baugh.** This is the oldest Bursum field on the shelf. Discovered in 1949, this field now has 11 wells producing, 10 flowing, and one pumping. The total production of these wells to March 1, 1955 was 2,524,415 barrels, or an average of 229,492 barrels per well. The average per acre/foot recovery had been 287 barrels.

Three wells, including the discovery, have produced over 300,000 barrels and are still flowing. Although this field is developed on 40-acre spacing, the well arrangements are such that potentially more acreage can be drained.

Drilling and Completion. The drilling and completion costs for a flowing well on the Shelf average $140,000. Conventional completion methods are used, with very little stimulation being necessary. The close proximity and thinness of reservoirs calls for extreme care in evaluating any tests that may overlap reservoirs.

Forecast. The widespread nature of the Bursum reservoirs makes this horizon potentially important for future development. Undoubtedly, many more fields will be found, some in anticlinal accumulations and some trapped by truncation of reservoirs around the flanks of such features as the Central basin platform.

The ultimate recovery from the Bursum will be about 200 barrels per acre/foot. On the basis of this figure, a return on an investment would be only 2-1, and operators are justified in being reluctant to drill.

However, the high recoveries of the Baugh field indicate that more than 40 acres can be effectively drained, and development on 80-acre spacing would be practicable. This would give a more desirable 4-1 return on investment and justify continuing exploratory work.—**The End**

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• WILDCAT DRILLING—IN AUGUST AND FIRST EIGHT MONTHS, 1955-1954

STATE or DISTRICT	MONTH OF AUGUST, 1955						FIRST EIGHT MONTHS, 1955–1954								
	New Fields			Total Discoveries	Dry Wildcats	Total Wildcat Tests	New Fields			Total Discoveries		Dry Wildcats		Total Wildcat Tests	
	Oil	Distillate	Gas				Oil	Distillate	Gas	8 Mo. 1955	8 Mo. 1954	8 Mo. 1955	8 Mo. 1954	8 Mo. 1955	8 Mo. 1954
Alabama	..	..	..	..	2	2	..	..	..	..	..	32	45	32	45
Arizona	..	..	..	..	..	..	..	..	..	..	..	4	8	4	8
Arkansas	1	..	..	1	21	22	9	..	2	11	3	89	67	100	70
California	2	..	..	2	32	34	14	..	3	17	14	205	228	222	242
Colorado	3	..	3	6	60	66	27	1	18	46	45	502	333	548	378
Florida	..	..	..	..	1	1	..	..	..	..	1	20	22	20	23
Georgia	..	..	..	..	..	..	..	..	..	..	..	....	7	....	7
Idaho	..	..	..	..	..	..	..	..	1	1	..	2	1	3	1
Illinois	1	..	..	1	58	59	13	..	2	15	17	435	392	450	409
Indiana	..	..	..	..	14	14	9	..	1	10	10	117	156	127	166
Kansas	11	..	1	12	65	77	103	..	26	129	85	601	502	730	587
Kentucky	1	..	..	1	2	3	13	..	2	15	21	65	33	80	54
Louisiana	3	3	1	7	42	49	26	18	3	47	52	307	251	354	303
North Louisiana	1	..	..	1	17	18	6	2	..	8	8	118	94	126	102
South Louisiana	2	3	1	6	25	31	20	16	3	39	44	189	157	228	201
Michigan	..	..	1	1	22	23	2	..	1	3	9	133	141	136	150
Mississippi	..	..	..	..	10	10	6	1	..	7	3	107	105	114	108
Missouri	..	..	..	..	..	..	..	..	..	..	..	17	6	17	6
Montana	1	..	..	1	22	23	6	..	..	0	5	77	60	83	65
Nebraska	4	..	..	4	23	27	27	..	..	27	18	205	88	232	106
Nevada	..	..	..	..	..	..	..	..	..	..	1	4	9	4	10
New Mexico	4	1	6	11	6	17	20	2	21	43	41	95	113	138	154
North Dakota	..	..	..	..	7	7	3	..	..	3	1	33	74	36	75
Ohio	..	..	..	..	1	1	..	..	1	1	..	14	9	15	9
Oklahoma	6	2	..	8	61	69	64	9	12	85	95	412	477	497	572
Oregon	..	..	..	..	..	..	..	..	..	..	..	1	....	1	....
Pennsylvania	..	..	..	..	..	..	..	..	1	1	..	2	....	3	....
South Dakota	..	..	..	..	1	1	..	..	..	..	1	7	10	7	11
Texas	66	9	5	80	360	440	372	57	44	473	493	2,737	2,797	3,210	3,290
Dist. 1: South Central	1	..	..	1	24	25	17	4	1	22	26	255	194	277	220
Dist. 2: Middle Gulf	4	1	..	5	31	36	12	10	6	28	24	174	182	202	206
Dist. 3: Upper Gulf	4	2	..	6	24	30	14	15	7	36	28	265	272	301	300
Dist. 4: Lower Gulf-S.W.	5	3	1	9	37	46	23	15	6	44	38	274	251	318	289
Dist. 5: East Central	..	1	..	1	12	13	3	3	..	6	2	92	96	98	98
Dist. 6: Northeast	..	..	..	..	16	16	3	3	..	6	5	124	107	130	112
Dist 7-B: North Central	20	1	1	22	106	128	112	1	8	121	142	616	591	737	733
Dist. 7-C: West Central	9	..	2	11	22	33	31	..	7	38	46	186	246	224	292
Dist. 8: West	10	..	..	10	38	48	56	..	1	57	76	300	276	357	352
Dist. 9: North	13	..	1	14	43	57	99	1	7	107	95	416	541	523	636
Dist. 10: Panhandle	..	1	..	1	7	8	2	5	1	8	11	35	41	43	52
Utah	..	..	..	..	5	5	6	..	3	9	4	40	21	49	25
West Virginia	..	..	..	..	2	2	..	..	7	7	..	12	....	19	....
Wyoming	2	..	..	2	13	15	18	..	2	20	52	113	138	133	190
Total United States	105	15	17	137	830	967	738	88	150	976	971	6,388	6,093	7,364	7,064

Wildcatting at Fast Pace

Year's tests lead 1954 by 4.2 percent.

By CECIL W. SMITH, WORLD OIL Staff

THIS YEAR'S wildcat drilling is well on its way toward a new industry record. The first eight months saw operations carried on at the fastest clip ever, and there seems little room for doubt that the final summary will show 1955 to be the greatest exploration period in history.

If the nation's wildcatters establish a new record, 1955 would become the thirteenth consecutive year that saw a new peak reached. Now volume of exploratory drilling is almost 3½ times greater that it was when the current series of new records started.

Through August, wildcat tests drilled in the U. S. totaled 7364, and that represented a gain of 300 wells, or 4.2 percent, over the 7064 completed in the first eight months of 1954. With four months remaining, it appears that the forecast 11,300 wildcats (WORLD OIL, August 15) will be reached and perhaps topped this year. That would be 3⅓ times the number of tests completed in 1941, which was the top pre-war wildcatting year.

Despite the substantial lead this year's exploration holds over 1954's, the measure of success has just barely kept pace. So far, a total of 976 tests successfully proved commercial production of oil, gas, or gas-distillate. At the same time a year ago, the count had been 971, which shows that the 300 more wildcats drilled this year resulted in only five new discoveries. Through August, 13.3 percent of all tries made producers, while last year's average had been 13.7 percent.

New oil fields opened this year totaled 738 against 726 a year ago, and gas-distillate discoveries numbered 88 to 82. The only decrease was in gas finds, which were 150 against last year's 163.

Summary of Results of Wildcat Drilling

ITEM	Aug., 1955	July, 1955	EIGHT MONTHS January-August 1955	1954	Percent Diff.
New Field Discoveries:					
Oil	105	99	738	726	+ 1.7
Distillate	15	12	88	82	+ 7.3
Gas	17	23	150	163	— 8.0
Total Discoveries	137	134	976	971	+ 0.5
Dry Wildcats	830	944	6388	6093	+ 4.8
Total Wildcat Tests	967	1078	7364	7064	+ 4.2
Percent Productive	14.2	12.4	13.3	13.7	.....
Percent Dry	85.8	87.6	86.7	86.3	.....

Calculating conditions observed by everyone directly associated with the drilling of wells . . .

Mud Rate and Weight Logging Promises Gas Sand Evaluation

By **JACK R. FRASER,** Chief Engineer,
Texas Eastern Production Corporation, Houston

PART 1—Surface measurements . . . should provide unique clues to the existence of gas-bearing sands penetrated by the bit . . . assist in evaluation.

PART 2—Mathematical and physical relations are developed to describe the behavior of the gas-cut mud plug as it rises through the annulus and is discharged at the surface.

PART 3—A hypothetical problem in rates of annulus discharge is solved.

PART 1: Introduction

FOR SEVERAL YEARS the writer has had the opinion that there are surface manifestations of the existence and quality of gas sands penetrated in rotary drilled holes which are being overlooked by engineers and geologists whose task it is to evaluate the producing possibilities of formations penetrated by the bit. It is the purpose of this paper to point out measurements which, if made continuously at the surface annulus of a rotary well, should provide unique clues to the existence of gas-bearing sands penetrated by the bit and, in addition, should assist in the evaluation of the producing possibilities of the sands.

Air introduced into the mud system of a well during connections may be observed later at the surface as the expanding air in the mud returns results in a temporary increase in velocity and decrease in density of the mud discharged from the annulus. Following round trips with the bit where larger volumes of air may be mixed into the mud, a complete circulation is often required before the annular mud discharge rate and density stabilize to those of the input mud to the drill pipe. These conditions have been observed by everyone directly associated with the drilling of wells.

Analogous to the above cited circumstances are those where a gas-bearing sand is drilled and small volumes of gas are mixed into the mud returns at the bottom of the hole. The gas-cut mud plug so formed is pumped up the annulus by the clean mud following it, and a surge in rate of discharge is sometimes observed at the annulus. The mud discharged during this surge is of less density than the clean mud being pumped around the bit. It is apparent, then, that expanding gas in a rising column of gas-cut mud results in a differential between

input mud rate to the drill pipe and discharge mud rate from the annulus and, once the top of the gas-cut mud plug reaches the surface, the specific weight of the mud discharged is less than that of the mud pumped into the drill pipe. The differential in rates and densities remains in effect until all of the gas-cut mud column is pumped out of the hole. The true mud density reduction due to gas-cutting is rarely if ever measured because a large part of the entrained gas has escaped from the mud by the time it is weighed in conventional equipment provided for this purpose.

In the following sections of this article, the writer seeks to analyze the differential in rates and density due to gas-cutting with a view to establishing the qualitative and quantitative utility of continuous weight and rate data. In Part 2, the mathematical and physical relations are developed to describe the behavior of the gas-cut mud plug as it rises through the annulus and is discharged at the surface. In Part 3, a hypothetical problem in rates of annular discharge is solved, and, in Part 4 the effect of some of the more important variables on the annular rate of discharge is investigated. In Part 5, the utility of continuous mud density measurements is discussed. Part 6 is a summarizing discussion.

PART 2: Derivations

In order to analyze the behavior of the annular plug of gas-cut mud, several simplifying assumptions are made but they are not of such importance to the physics of the problem that their use obscures the relative magnitude of the more important factors involved. The assumptions used hereinafter are as follows:

1. The clean mud is incompressible.
2. The effective annulus may be considered as having a uniform average cross-sectional area.
3. At all times before the top of the gas-cut mud reaches the surface, the pressure at the bottom of the plug, P_1 equals the pressure at the top of the plug, P_2, plus a constant, D. Symbolically: $P_1 - P_2 = D$; where D equals the combined weights of the gas and mud in the gas-cut mud plug, divided by the cross-sectional area of the annulus.
4. The flowing mud pressure gradient in the annulus is taken to be the same as the static gradient. At first, this seems to be a gross over-simplification of the mechanics involved but, as it effects the problem, this approximation is of minor significance.
5. The expansion of the gas in the annulus occurs at a constant temperature and the gas behaves as a "perfect gas."

With these five assumptions and approximations we will now proceed with the analytics.

A. "Point Value" of Specific Weight of The Gas-Cut Mud.

Consider a small volume of gas and mud mixture at the initial bottom-hole mixing pressure, P_o#/ft.^{2} (See Figure 1.) The specific weight of the gas and mud in the gas-cut mud mix at P_o, are W_{go} and W_m pounds per cubic foot, respectively. V_m and V_{go} are the volumes of clean mud and gas, respectively, in the unit volume of gas-cut mud. The specific weight of a substance is defined as its weight per unit volume and for the small mass of gas-cut mud under study, we have:

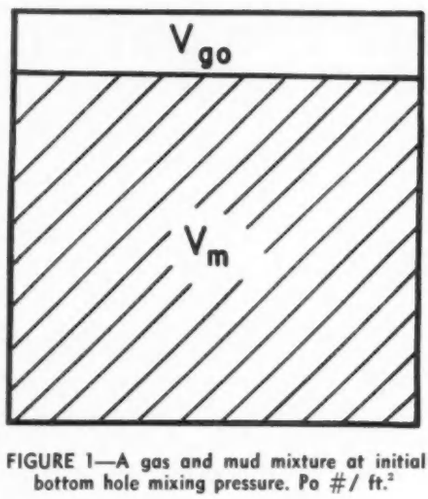


FIGURE 1—A gas and mud mixture at initial bottom hole mixing pressure. Po #/ ft.^{2}

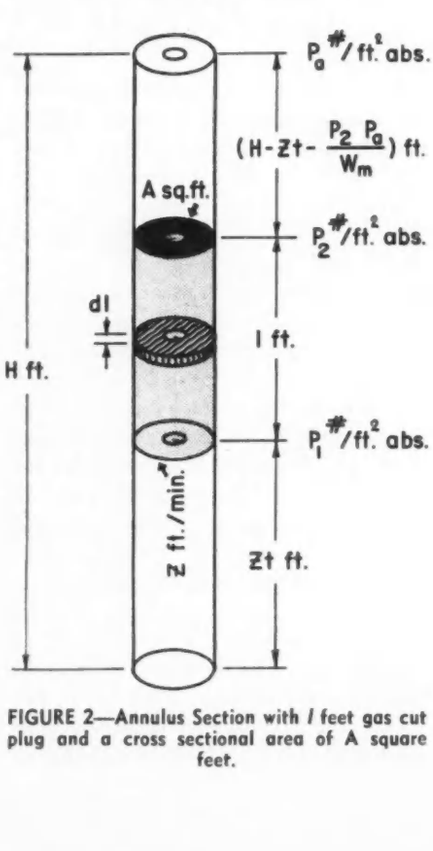


FIGURE 2—Annulus Section with l feet gas cut plug and a cross sectional area of A square feet.

$$W_o = \frac{\text{Total weight of GCM}}{\text{Total volume of GCM}} \quad (1)$$

$$\text{Total wt. of GCM} = (V_{go} \times W_{go}) + (V_m \times W_m) \quad (2)$$

Now, let $R = \frac{V_m}{V_{go}}$ where R and V_{go} are measured at P_o. Then,

$$V_m = RV_{go} \quad (3)$$

When RV_{go} is substituted in Equation 2 for V_m, we have:

$$\text{Total wt. of GCM} = V_{go} \times W_{go} + RV_{go} W_m = V_{go} (W_{go} + RW_m) \quad (4)$$

Similarly: $$\text{Total vol. of GCM} = V_m + V_{go} = V_{go} (R + 1) \quad (5)$$

Substituting Equations 4 and 5 in Equation 1, for total weight and total volume of the GCM, respectively, we have:

$$W_o = \frac{V_{go} (W_{go} + RW_m)}{V_{go} (R + 1)} = \frac{W_{go} + RW_m}{(R + 1)} \quad (6)$$

Where:

W_o = Sp. Wt. of GCM at P_o; #/cf.

For the specific weight of the gas-cut mud at any pressure other than P_o, we have:

$$W = \frac{W_{go} + RW_m}{R + \frac{P_o}{P}} \quad (7)$$

B. Length of the Gas-Cut Mud Plug, In Terms of Bottom and Top Plug Pressures:

In Figure 2, the annulus is repre-

sented by a uniform hollow cylinder. The gas-cut portion is shaded and has length l ft. and cross-sectional area, A sq. ft. The bottom of the plug moves up-hole at a velocity of Z ft. min. The depth of the well is H ft.

For the differential element of volume of gas-cut mud we have:

$$dP = -Wdl \qquad (8)$$

where W is defined by Equation 7. Making the substitution for W, we obtain:

$$dP = -\frac{W_{go} + RW_m}{R + \frac{P_o}{P}}\ dl \qquad (9)$$

$$\int_{l_t}^{l_2} -dl = \int_{P_1}^{P_2} \frac{R + \frac{P_o}{P}}{W_{go} + RW_m} dP \qquad (10)$$

Now Equation 10 may be integrated between the indicated limits to obtain:

$$l_b = \frac{1}{W_{go} + RW_m}\left[R(P_1 - P_2) + P_o \ln \frac{P_1}{P_2}\right] \qquad (11)$$

Where ln = $\log_e$, and,

l_b = length of plug for all times prior to breakthru ft.

Equation 11 gives the length of the gas-cut mud column between any two pressures within or at the extremes of the column. For the period prior to breakthrough, we will be interested in the total length of the plug and P_1 and P_2 will be taken as the bottom and top plug pressures, respectively. After breakthrough, we will be interested in the length of the gas-cut mud column between a fixed top pressure and a decreasing bottom pressure.

C. Rate of Annulus Discharge Before Breakthrough:

Referring to Figure 2, if clean mud is pumped into the drill-pipe at a constant rate, Q_m cf/min., the bottom of the gas-cut mud plug will be pushed up the annulus at a linear rate of Z ft./min., where $Z = Q_m/A$. The top of the gas-cut mud plug will move farther in any time interval than the bottom of the plug due to the expansion of the gas contained within the plug. Now, if we let t = o be the instant the bottom of the gas-cut mud plug leaves the bottom of the hole, the discharge rate from the annulus may be expressed as follows:

$$Q_b = \frac{dV_d}{dt} = A\left(Z + \frac{dl}{dt}\right) \qquad (12)$$

Where:

V_d = Vol. discharged to any time; cf

t = Time from instant plug leaves bottom; minutes.

A = Annular Area; sq. ft.

l_b = Length of plug; ft.

Z = Rate of rise of bottom of plug; ft./min.

Q_b = Rate of discharge before breakthrough; cf/min.

From Figure 2, again, it may be observed that:

$$l_b = H - Zt - \frac{P_2 - P_a}{W_m} \qquad (13)$$

Where: P_a = Pressure at the surface of the annulus; lbs/ft² absolute. Differentiating Equation 13 with respect to t gives:

$$\frac{dl_b}{dt} = -Z - \frac{1}{W_m}\ \frac{dP_2}{dt} \qquad (14)$$

Now, as stated earlier:

$$D = P_1 - P_2 \qquad (15)$$

Where: D = (Wt. gas in GCM plug + Wt. mud in GCM plug) / A

Substituting D for $P_1 - P_2$, and $D + P_2$ for P_1, in Equation 11, we obtain:

$$l_b = \frac{1}{W_{go} + RW_m}\left[RD + P_o \ln\left(\frac{D + P_2}{P_2}\right)\right] \qquad (16)$$

When Equation 16 is differentiated with respect to t, we have:

$$\frac{dl}{dt} = \frac{1}{W_{go} + RW_m} \cdot \left[P_o \frac{P_2}{D + P_2} \cdot \frac{P_2 \frac{dP_2}{dt} - (D + P_2)\frac{dP_2}{dt}}{P_2^2}\right]$$

which reduces to:

$$\frac{dl_b}{dt} = \left[\frac{-DP_o}{(W_{go} + RW_m)(D + P_2)P_2}\right]\frac{dP_2}{dt} \qquad (17)$$

Letting everything within the brackets in Equation 17 equal F, we have:

$$F = \frac{-DP_o}{(W_{go} + RW_m)(D + P_2)P_2} \qquad (18)$$

and

$$\frac{dl_b}{dt} = F\frac{dP_2}{dt}; \text{ or, } \frac{dP_2}{dt} = \frac{1}{F}\ \frac{dl_b}{dt} \qquad (19)$$

Solving Equation 14 and Equation 19, simultaneously, for $\frac{dl_b}{dt}$, we obtain:

$$\frac{dl_b}{dt} = -Z - \frac{1}{W_m} \cdot \frac{1}{F}\ \frac{dl_b}{dt}\ ; \text{ which reduces to: } \frac{dl_b}{dt} = \frac{-Z\,W_m F}{W_m F + 1} \qquad (20)$$

Now, substituting $\frac{dl_b}{dt}$ from Equation 20 into Equation 12, we get:

$$\frac{dV_d}{dt} = A\left(Z + \frac{-Z\,W_m F}{W_m F}\right);$$

which reduces to:

$$\frac{dV_d}{dt} = Q_b = \frac{AZ}{W_m F + 1} \qquad (21)$$

Now, since $AZ = Q_m$, where Q_m is the clean mud rate to the drill pipe, cf/min, we have:

$$Q_b = \frac{Q_m}{W_m F + 1} \qquad (22)$$

Equation 22 gives the rate of discharge from the annulus for all times prior to the instant the top of the gas-cut mud breaks through to the surface of the annulus. For the period after breakthrough, different relations are required.

D. Rate of Annulus Discharge After Breakthrough of the Top of the Gas-Cut Mud:

For all times after breakthrough and continuing until the gas-cut mud plug is completely out of the annulus, we have the relation:

$$Q_a = \frac{dVd}{d\bar{t}} = \frac{-A}{W_d}\ \frac{dP_1}{d\bar{t}} \qquad (23)$$

Where:

V_d = Vol. discharged to any time; cf.

$\bar{t}$ = time from the instant of breakthrough; minutes.

P_1 = pressure at bottom of plug; lbs/sq. ft.

$Q_a = \frac{dV_d}{d\bar{t}}$ = rate of discharge after breakthrough; cf/min

W_d = Sp. wt. of gas-cut mud at annulus discharge; lbs/cf.

After breakthrough, the pressure at the top of the remaining gas-cut mud column remains constant at P_a, atmospheric pressure or the pressure at which the rate measurement is being made. Substituting P_a into Equation 11 for P_2, we obtain:

$$l_a = \frac{1}{W_{go} + RW_m}\left[R(P_1 - P_a) + P_o \ln \frac{P_1}{P_a}\right] \qquad (24)$$

Where: l_a = length of plug after breakthrough; ft. Differentiating Equation 24 with respect to $\bar{t}$, gives:

$$\frac{dl_a}{d\bar{t}} = \left[\frac{R + \frac{P_o}{P_1}}{W_{go} + RW_m}\right]\frac{dP_1}{d\bar{t}} \qquad (25)$$

(It should be noted that Equation 25 may be taken directly from Equation 10 by the substitution of P_1 for P.)

After breakthrough, the length of

the plug remaining in the annulus diminishes by Z ft./min.; so we have:

$$\frac{dl_a}{dt} = -Z \qquad (26)$$

Substituting Equation 26 into Equation 25 for $\frac{dl_a}{dt}$, we obtain:

$$\frac{dP_1}{dt} = \frac{-Z(W_{go} + RW_m)}{R + \frac{P_o}{P_1}} \qquad (27)$$

When $\frac{dP_1}{dt}$ from Equation 27 is substituted into Equation 23, we have:

$$Q_a = \frac{dV_d}{dt} = \frac{AZ}{W_d}\left[\frac{W_{go} + RW_m}{R + \frac{P_o}{P_1}}\right] \qquad (28)$$

Now:

$AZ = Q_m$, and from Equation 7,

$$W_d = \frac{W_{go} + RW_m}{R + \frac{P_o}{P_a}} \qquad (29)$$

Substituting the above into Equation 28, we get, finally:

$$Q_a = Q_m\left[\frac{R + \frac{P_o}{P_a}}{R + \frac{P_o}{P_1}}\right] \qquad (30)$$

E. Discontinuity in Discharge Rates at Breakthrough:

At first thought, it appeared that the calculated rate of discharge should be identical at the instant of breakthrough, using either Equation 30 or Equation 22. Upon further analysis, however, it developed that a sizable change in rate of discharge will occur across the instant of breakthrough. By manipulation of the foregoing equations, it may be proved that:

$$Q_a = Q_b \cdot \frac{W_m}{W_d} \cdot \frac{\frac{dP_1}{dt}}{\frac{dP_1}{dt}} \qquad (31)$$

By substitution for W_d, $\frac{dP_1}{dt}$ and $\frac{dP_1}{dt}$ Equation 31 may be expressed as:

$$Q_a = Q_b\left[\frac{\left(R + \frac{P_o}{P_a}\right)\left((P_1 - D)\,P_1\right) - \left(W_m\,D\,P_o\right)}{\left(R + \frac{P_o}{P_1}\right)\left((P_1 - D)\,P_1\right)}\right] \qquad (32)$$

F. The Average Specific Weight of the Gas-Cut Mud Plug:

The average specific weight of the gas-cut mud between the two pressure levels, P_1 and P_2, is defined as follows:

$$W_{avg} = \frac{\int_{P_2}^{P_1} W\,dP}{P_1 - P_2}; \qquad (33)$$

where W is defined by Equation 7. Making the substitution for W, we obtain:

$$W_{avg} = \frac{W_{go} + RW_m}{P_1 - P_2}\int_{P_2}^{P_1}\frac{dP}{R + \frac{P_o}{P}} =$$

$$\frac{W_{go} + RW_m}{P_1 - P_2}\int_{P_2}^{P_1}\frac{P\,dP}{RP + P_o} \qquad (34)$$

Integrating Equation 34 between the limits indicated gives:

$$W_{avg} = \frac{W_{go} + RW_m}{(P_1 - P_2)R}$$

$$\left[(P_1 - P_2) - \frac{P_o}{R}\left(\ln\frac{RP_1 + P_o}{RP_2 + P_o}\right)\right] \qquad (35)$$

This completes the derivations, and there follows a listing of the more important and useful equations together with an explanation of the symbols used.

Summary List of Equations

$$V_m = RV_{go} \qquad (3)$$

$$W = \frac{W_{go} + RW_m}{R + \frac{P_o}{P}} \qquad (7)$$

$$l_b = \frac{1}{W_{go} + RW_m}\left[R\,(P_1 - P_2) + P_o \ln\frac{P_1}{P_2}\right] \qquad (11)$$

$$l_b = H - Zt - \frac{P_2 - P_a}{W_m} \qquad (13)$$

$$D = P_1 - P_2 \qquad (15)$$

$$l_b = \frac{1}{W_{go} + RW_m}\left[RD + P_o \ln\frac{D + P_2}{P_2}\right] \qquad (16)$$

$$F = \frac{-DP_o}{(W_{go} + RW_m)\,(D + P_2)\,P_2} \qquad (18)$$

$$Q_b = \frac{AZ}{W_mF + 1} = \frac{Q_m}{W_mF + 1} \qquad (21 \text{ \& } 22)$$

$$l_a = \frac{1}{W_{go} + RW_m} \cdot \left[R\,(P_1 - P_a) + P_o \ln\frac{P_1}{P_a}\right] \qquad (24)$$

$$W_d = \frac{W_{go} + RW_m}{R + \frac{P_o}{P_a}} \qquad (29)$$

$$Q_a = \frac{AZ}{W_d}\left(\frac{W_{go} + RW_m}{R + \frac{P_o}{P_1}}\right) = Q_m\left(\frac{R + \frac{P_o}{P_a}}{R + \frac{P_o}{P_1}}\right) \qquad (28 \text{ \& } 30)$$

$$\bar{t} = \frac{l^* - l_a}{Z}$$

$$W_{avg} = \frac{W_{go} + RW_m}{(P_1 - P_2)\,R}\left[(P_1 - P_2) - \frac{P_o}{R} \cdot \ln\left(\frac{RP_1 + P_o}{RP_2 + P_o}\right)\right] \qquad (35)$$

Where:

A = Cross-Sectional Areal of Annulus; sq. ft.

D = Difference in pressure between bottom and top of gas-cut mud plug; lbs/sq. ft. absolute.

F = $\frac{dl_b}{dP_2}$ for the period before breakthrough.

H = Depth of well, ft.

l_b = Length of gas-cut mud plug before breakthrough; ft.

l_a = Length of gas-cut mud plug after breakthrough; ft.

l^* = Length of gas-cut mud plug at the instant of breakthrough of the top of the plug; ft.

P_a = Atmospheric pressure, or pressure at which annular discharge rate is measured; lbs/ft², absolute.

P_o = Bottom-hole pressure in mud column at instant gas sand is drilled; lbs/ft², absolute.

P_1 = Pressure at bottom of gas-cut mud plug; lbs/ft², absolute.

P_2 = Pressure at top of gas-cut mud plug; lbs/ft², absolute.

$Q_a = \frac{dV_d}{dt}$ = Annular rate of discharge, after breakthrough; cf/min.

$Q_b = \frac{dV_d}{dt}$ = Annular rate of discharge, before breakthrough; cf/min.

$Q_m = AZ$ = Input rate for clean mud; cf/min.

R = Ratio $\frac{V_m}{V_{go}}$

t = Time elapsed from instant gas-cut mud plug leaves bottom of hole; minutes.

$\bar{t}$ = Time elapsed from instant of breakthrough of the top of the gas-cut mud at the surface; minutes.

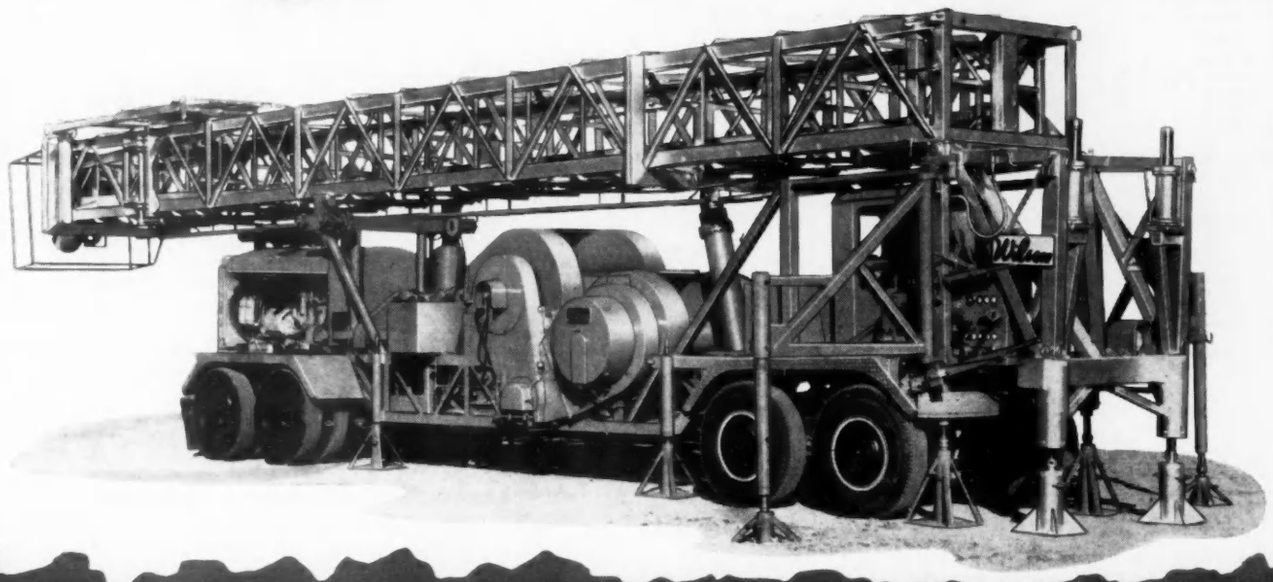
V_m = Volume clean mud in a unit volume of GCM at bottom hole conditions of pressure and temperature.

V_{go} = Volume gas in a unit volume of GCM at bottom hole conditions of pressure and temperature.

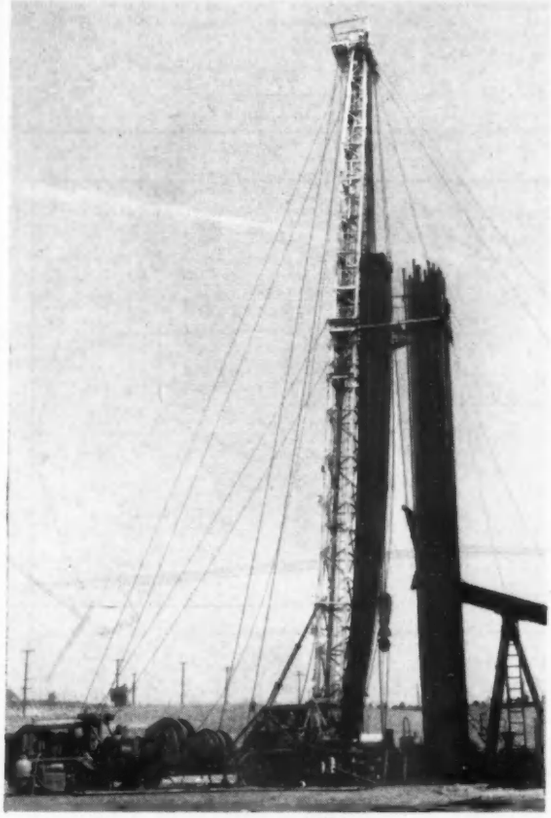
W_d = Specific weight of GCM at in-

THE Wilson WINCHMOBILE

MOGUL "42" TORCAIR MODEL



RATED CAPACITY 16,000 Feet 2½" Tubing | **OVERALL DIMENSIONS** Length: 54 feet Width: 96 inches Height: 13 ft. 6 in. | **WEIGHT** Front Axles 26,250 lbs. Rear Axles 41,520 lbs. Total 67,700 lbs.



FEATURES

- Drums mounted directly on vehicle frame, which eliminates the winch frame, saving several thousand pounds of weight.
- Mogul "42" double drum Torcair winch.
- Line capacity, upper drum, 16,200 ft. 9/16".
- Line capacity, lower drum, 5,500 ft. 7/8".
- Full air controls on winch located where desired.
- Aluminum pressure plates on Air-Tube clutches.
- Fabricated angle steel frame of "Man-Ten" steel.
- Mogul 96' fabricated angle steel mast, 260,000 lbs. capacity.
- Optional 90', 96' and 102' masts.
- Mast hydraulically raised, telescoped and with kickover jacks.
- No ground guy lines needed for most ordinary loads.
- Outrigger for mast wind bracing.
- General Motors 12107 *Twin* six diesel engine, with Allison torque converter.
- Engines optional, GM 110, Waukesha WAKBU and others.
- Allison TG-617 Torqmatic transmission with air controls.
- Parkersburg 15" double Hydrotarder with Air-Tube clutch.
- Eaton 82-F dual front axles with 11:00-20 tires.
- Both sets of front wheels steer, no dragging tires.
- Air power steering.
- Can be built in Mogul "42" or Super "38" size winch.
- Front Tandem axle suspension system of Wilson design using Hendrickson beams, is the simplest, lightest, and strongest system yet designed.

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TABLE 1

Solutions of Eq. 22., $Q_b = \frac{Qm}{W_m F + 1}$; Eq. 16., $l_b = \frac{1}{W_{go} + RW_m}\left[RD + P_o \ln \frac{D + P_2}{P_2}\right]$; and Eq. 13., $t = \frac{H - \left(l_b + \frac{P_2 - P_a}{W_m}\right)}{Z}$

1	2	3	4	5	6	7	8	9	10	11	12
P_2 #/ft.²	D+P_2	P_2 (D+P_2)	F	W_m F	W_m F+1	Q_b cf/min.	$\frac{D+P_2}{P_2}$	$\log_{10}\frac{D+P_2}{P_2}$	$P_o \ln\frac{D+P_2}{P_2}$	RD + $P_o \ln\frac{D+P_2}{P_2}$	l_b ft.
600,000	760,050	456,030x10⁶	—.000003518	—.0002814	.9997	50.02	1.2667	.08874	163,908	160,213,908	2002.03
400,000	560,050	224,020x10⁶	—.000007162	—.0005730	.9994	50.03	1.4001	.14616	269,965	160,319,965	2003.36
200,000	360,050	72,010x10⁶	—.00002228	—.001782	.9982	50.09	1.8003	.25534	471,627	160,521,627	2005.88
100,000	260,050	26,005x10⁶	—.00006169	—.004935	.9951	50.25	2.6005	.41505	766,620	160,816,620	2009.56
50,000	210,050	10,502x10⁶	—.00015276	—.01222	.9878	50.62	4.2010	.62335	1,151,361	161,201,361	2014.37
25,000	185,050	4,626x10⁶	—.00034681	—.02774	.9723	51.42	7.4020	.86935	1,605,736	161,655,735	2020.05
15,000	175,050	2,626x10⁶	—.00061094	—.04888	.9511	52.57	11.6700	1.06707	1,970,936	162,020,936	2024.61
8,000	168,050	1,344x10⁶	—.0011937	—.09550	.9045	55.28	21.006	1.32235	2,442,452	162,492,452	2030.51
4,000	164,050	656x10⁶	—.0024456	—.1956	.8044	62.16	41.013	1.61292	2,979,150	163,029,150	2037.21
3,000	163,050	489x10⁶	—.0032808	—.2625	.7375	67.80	54.350	1.73520	3,205,008	163,255,008	2040.03
2,600	162,650	423x10⁶	—.0037927	—.3034	.6966	71.78	62.558	1.79629	3,317,845	163,367,845	2041.44
2,400	162,450	390x10⁶	—.0041136	—.3291	.6709	74.53	67.688	1.83051	3,381,051	163,431,051	2042.23
2,200	162,250	360x10⁶	—.0044564	—.3565	.6435	77.77	73.750	1.86776	3,449,854	163,499,854	2043.09
2,160	162,210	350x10⁶	—.0045838	—.3667	.6333	78.95	75.097	1.87562	3,464,371	163,514,371	2043.27

TABLE 2

Solutions of Eq. 28, $Q_a = \frac{AZ}{W_d}\left(\frac{W_{go} + RW_m}{R + P_o/P_1}\right)$; Eq. 24, $l_a = \frac{1}{W_{go} + RW_m}\left[R(P_1 - P_a) + P_o \ln \frac{P_1}{P_a}\right]$; and $\bar{t} = \frac{l^* - l_a}{Z}$

1	2	3	4	5	6	7	8	9	10	11	12	13	14
P_1 (#/ft²)	$\frac{P_o}{P_1}$	$R + \frac{P_o}{P_1}$	$\frac{W_{go}+RW_m}{R+P_o/P_1}$	Q_a (cf/min)	$\frac{P_1}{P_a}$	$\log_{10}\frac{P_1}{P_a}$	$P_o \ln\frac{P_1}{P_a}$	$(P_1 - P_a)$	R $(P_1 - P_a)$	R $(P_1 - P_a) + P_o \ln\frac{P_1}{P_a}$	l_a (ft.)	$l^* - l_a$	$\bar{t} = \frac{l^* - l_a}{Z}$ (min.)
162,210	4.945	1004.95	79.63	68.23	75.097	1.87562	3,464,371	160,050	160,050,000	163,514,371	2043.3	0	0
120,000	6.685	1006.69	79.49	68.11	55.555	1.74472	3,222,592	117,840	117,840,000	121,062,592	1512.8	530.5	5.31
80,000	10.027	1010.03	79.23	67.89	37.037	1.56863	2,897,344	77,840	77,840,000	80,737,344	1008.9	1034.4	10.34
40,000	20.054	1020.05	78.45	67.22	18.519	1.26762	2,341,363	37,840	37,840,000	40,181,363	502.1	1541.2	15.41
20,000	40.108	1040.11	76.94	65.92	9.2593	.96658	1,785,325	17,840	17,840,000	19,625,325	245.2	1798.1	17.98
10,000	80.216	1080.22	74.08	63.48	4.6296	.63039	1,164,364	7,840	7,840,000	9,004,364	112.5	1930.8	19.31
5,000	160.432	1160.43	68.96	59.09	2.3148	.36451	673,270	2,840	2,840,000	3,513,270	43.9	1999.4	19.99
4,000	200.540	1200.54	66.66	57.11	1.8519	.26762	494,309	1,840	1,840,000	2,334,309	29.2	2014.1	20.14
3,000	267.387	1267.39	63.14	54.10	1.3889	.14267	263,519	840	840,000	1,103,519	13.8	2029.5	20.29
2,600	308.523	1308.52	61.16	52.40	1.2037	.08052	148,725	440	440,000	588,725	7.4	2035.9	20.36
2,400	334.233	1334.23	59.98	51.39	1.1111	.04575	84,503	240	240,000	324,503	4.1	2039.2	20.39
2,300	348.765	1348.76	59.33	50.84	1.0648	.02727	50,369	140	140,000	190,369	2.4	2040.9	20.41
2,160	371.370	1371.37	58.35	50.00	1.0000	0	0	0	0	0	0	2043.3	20.43

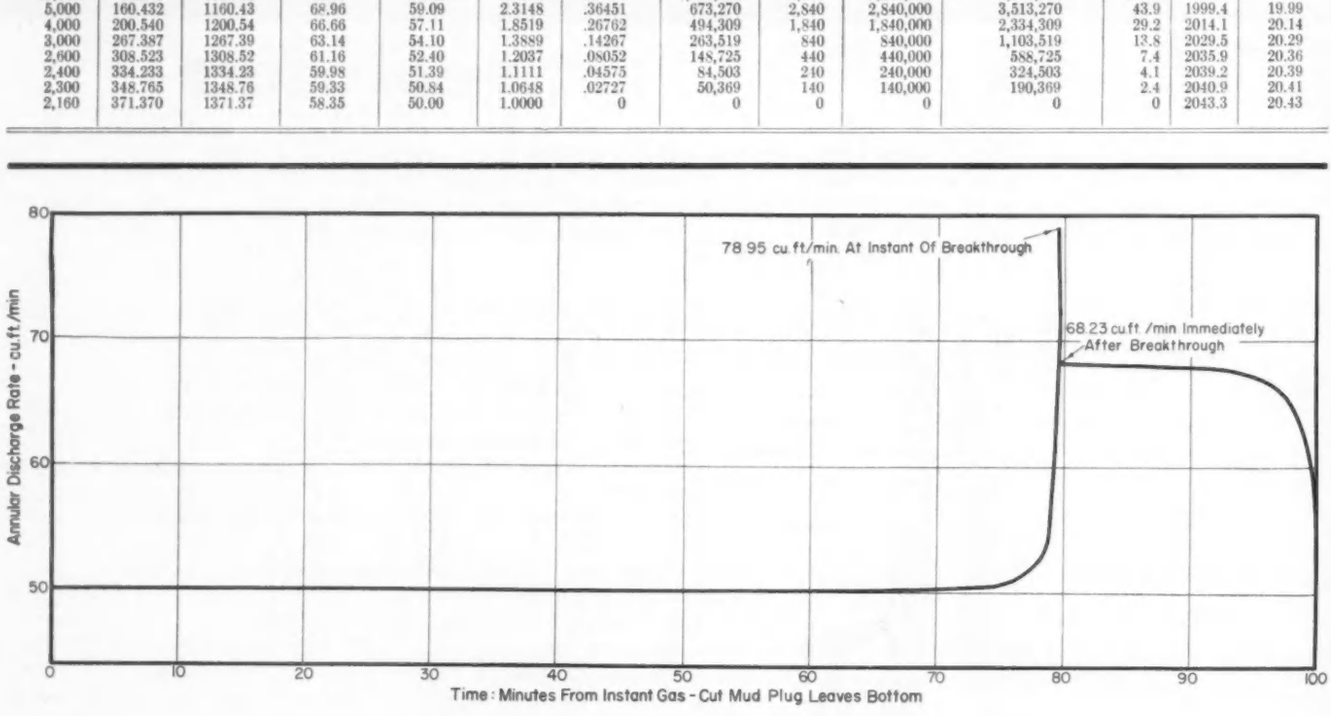


FIGURE 3—Rate vs. time data taken from Tables 1 and 2.

stant of discharge at surface; lbs/cf.

W = Specific weight of GCM at any pressure, P; lbs/cf.

W_{avg} = Average specific weight of a GCM column between two pressure levels within the column, lbs/cf.

W_{go} = Original specific weight of the gas in the GCM at P_o; lbs/cf.

W_m = Specific weight of clean mud; lbs/cf.

Z = Rate of rise of bottom of GCM plug; ft/min.

ln = $\log_e$.

13	14	15	16	17
P_2-P_a	$\frac{P_2-P_a}{W_m}$	$l_b+\frac{P_2-P_a}{W_m}$	$H-\left(l_b+\frac{P_2-P_a}{W_m}\right)$	t min.
597,840	7473.0	9475.0	525.0	5.25
397,840	4973.0	6976.4	3023.6	30.24
197,840	2473.0	4478.9	5521.1	55.21
97,840	1223.0	3232.6	6767.4	67.67
47,840	598.0	2612.4	7387.6	73.88
22,840	285.5	2305.6	7694.4	76.94
12,840	160.5	2185.1	7814.9	78.15
5,840	73.5	2103.5	7896.5	78.96
1,840	23.0	2060.2	7939.8	79.40
840	10.5	2050.5	7949.5	79.50
440	5.5	2046.9	7953.1	79.53
240	3.0	2045.2	7954.8	79.55
40	0.5	2043.6	7956.4	79.56
0	0	2043.3	7956.7	79.57

About the Author

JACK R. FRASER, chief petroleum engineer for the Texas Eastern Production Corporation, was graduated from the University of Pittsburgh with a B.S. degree in petroleum and natural gas engineering. Prior to joining the Texas Eastern Production Corporation as district geologist in 1951, Fraser had been associated with Shell Oil Company as production geologist in Oklahoma City. He is a member of the AIME, The Houston Chapter of API, and a registered professional engineer in the state of Texas.

PART 3: A Problem in Rates of Annular Discharge

As an example of predicting the annular rate of discharge from a well in which a gas sand has just been drilled, and the gas-cut mud plug formed is being pumped up the annulus, we will assume the following data:

Top Sand—9990 feet.
Base Sand—10,000 feet.
Sand Thickness—10 feet.
Drilling Rate for Sand—2 minutes per foot.
Time Required to Cut Sand—20 minutes.
Mud Circulating Rate—50 cf/min.
Specific Weight of Mud—80 lbs. per cubic foot.
Annular Area—0.5 sq. ft.
Gas Content of Sand per Linear Foot Drilled—0.1 cf. (Measured at P_o and T_o).
Specific Wt. of Gas—25 lbs/cf (Measured at P_o and T_o).
Bottom Hole Pressure Where Sand Was Cut—802,160 lbs./ft.^{2} absolute.
Pressure At Which Mud Rate Is Being Measured At Surface—2160 lbs/ft.^{2} absolute.

$$R=\frac{V_m}{V_g}=\frac{50\text{ cf/min}}{.05\text{ cf/min}}=1000\ \frac{\text{cf mud}}{\text{cf gas}}$$

$$Z=\frac{50\text{ cf/min}}{0.5\text{ sq. ft.}}=100\text{ ft/min.}$$

$$D=\frac{(50\text{ cf mud/min}\times 80\text{ lbs/cf}+.05\text{ cf gas/min}\times 25\text{ lbs/cf})\times 20\text{ min.}}{0.5\text{ sq. ft.}}$$

$D=150{,}050$ lbs/ft.^{2}

The rate-time history for the period before breakthrough of the top of the gas-cut mud to the surface is computed as follows:

1. Solve for F in Equation 18 for various values of P_2 (Columns 1 through 4, Table 1).

2. Solve for Q_b in Equation 22 using values of F determined in 1 above. (Columns 5, 6 and 7, Table 1.)

3. Relate l_b to P_2 by solving Equation 16 for the same values of P_2 used in 1 above. (Columns 8 through 12, Table 1.)

4. Solve for t in Equation 13, by inserting paired values of P_2 and l_b from columns 1 and 12, Table 1. (Columns 13 through 17, Table 1.)

The above procedure relates l_b, P_2, and Q_b, to t for the period from $t = {}_o$ to the instant of breakthrough of the top of the gas-cut mud plug.

The rate-time history for the period following breakthrough of the gas-cut mud plug may be computed as follows:

1. Evaluate the expression $\frac{W_{go}+RW_m}{R+P_o/P_1}$ in Equation 7 for various values of P_1 between P_1 at breakthrough, and $P_1 = P_a$. (Columns 1 through 4, Table 2.)

2. Solve for Q_a in Equation 28. (Column 5, Table 2.)

3. Solve for l_a in Equation 24 using same values of P_1, used in 1 above. (Columns 6 through 12, Table 2.)

4. Solve for $\bar{t}$ in terms of the l's calculated in 3, above. (Columns 13 and 14, Table 2.)

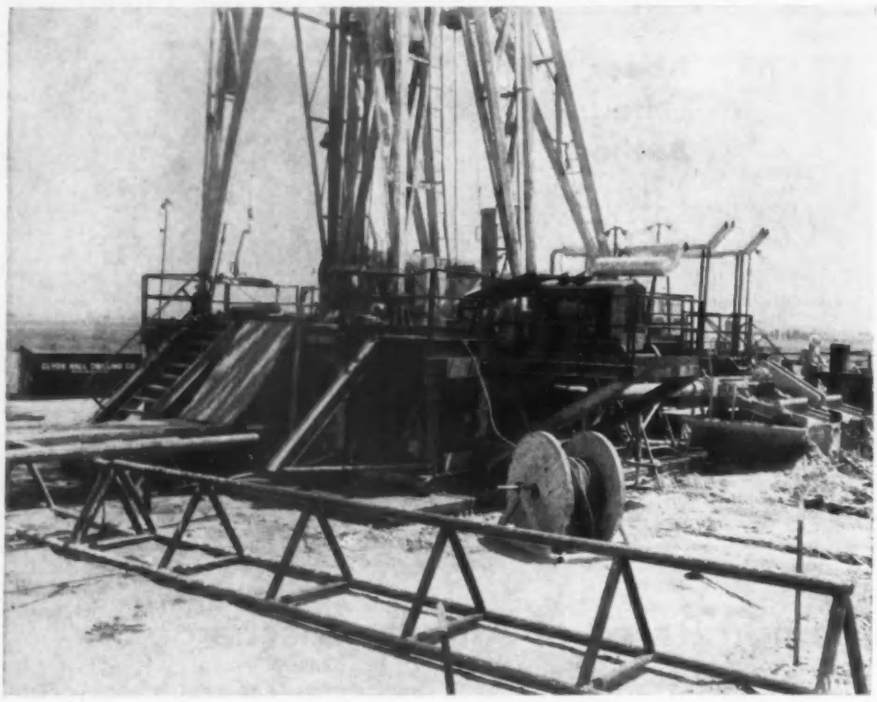
The rate vs. time data shown in Tables 1 and 2 are plotted on Figure 3. It is seen that the rate surge just before breakthrough is quite large, and that there is a considerable differential between input and discharge until the gas-cut mud is almost completely out of the hole. It is notable, also, that the whole plug lengthened only 41 feet, or about 2 percent in its entire trip from bottom hole to breakthrough.

The plot shown on Figure 3 should demonstrate more or less typical configuration of the rate-time relationship. In actual field measurement of annular discharge rate, one would expect the peak rate immediately before breakthrough to be not quite so high relative to the rate immediately thereafter because of minor mixing of the gas-cut mud with clean mud at the interface.

The area under the curve in Figure 3, to the right of the instant of breakthrough and above the input rate level, represents the total volume of the gas-cut mud plug measured at P_a and T_o. In an actual field measurement of this kind, however, the area under the curve would represent the total volume of the gas-cut mud plug at the pressure and temperature existing in the mud at the point of measurement and this volume can be corrected to bottom hole conditions or standard conditions, whichever is desired.

From drilling time and input mud rates, we can determine the volume of clean mud in the gas-cut mud plug and this may be subtracted from the total volume of the plug as determined from the area under the rate-time curve after the instant of breakthrough, to give a direct measurement

Continued on Page 150



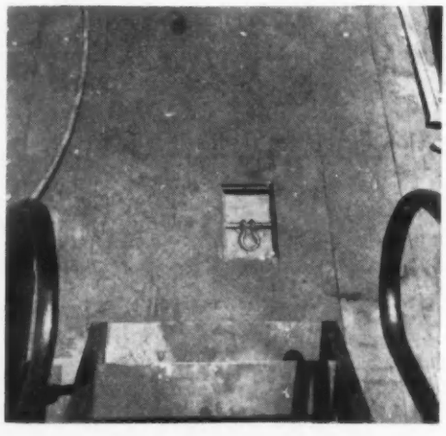
View from near front of rig showing removable outboard mounting of rotary engine; also pipe rack which parts at walkway. Latter feature facilitates fast moving and spudding next well, with most of drill pipe being transferred later.

Unit Keying—A Way to Cut Rigging Costs

Here's one answer to chopping costs at rig-up and tear-down time when your money is all going out and nothing coming in. Here's a rig designed to reduce costly time of these operations to a minimum.

AN UNUSUALLY high degree of careful planning and design work in the unitization of major components is paying dividends for Clyde Hall Drilling Company, Bakersfield, Calif.

Aimed primarily at cutting time required in rigging-up and tearing-out operations, the unitization also simplifies drilling operations, leaves working areas less encumbered, and contributes toward increased safety of workmen. The rig, equipped with a 131-foot mast, is rated at between 5000 and 9000 feet capacity with 4½-inch drill pipe.



Recessed lifting loops permit easy handling and positioning of 8 x 16-foot, double-thickness 3 x 12 plank mats.

The planning, laying-out and unitization of the principal rig components are keyed to one sub-base. When either of the two sub-bases is properly measured and located in relation to the well, tape measures from that time on can be put away. Every subsequent piece of equipment set up at the location automatically falls into its proper position without further adjustment or shifting. This is made possible through the use of a system of spacer bars and pins which serve the dual purpose of not only simplifying spotting of the various units, but thereafter holding them in place against any tendency to "wander" or shift due to vibrations or stresses incurred during drilling operations. Typical of these spacer bars and pins are the installations shown in the accompanying photographs.

Of considerable importance, also, in speeding rigging-up operations is the contractor's use of wooden mats. Each mat, measuring approximately 8 x 16 feet, is built up of two thicknesses of 3 x 12 planks. The result of the use of mats, of which there are 20 in a typical installation, is that a minimum of location work is required before moving in; a reasonably flat location being all that is required.

There is little danger of a rig corner settling into soft ground during drilling operations; and there is little work involved in keeping surroundings hosed down and clean. Recessed steel lifting loops in each mat permit easy handling and loading.

Side Rails Guide Pump Base. The mud pump, mounted on conventional skid base, is spotted and held in place against sideways movement by two parallel lengths of 3-inch angle iron, the latter placed with the open side looking downward. The rails are welded to the steel edging bolted to the mats, the latter in turn, being accurately located by the spacer bar and pins tying them to the rig subbase. When the pump is skidded into place between the angle iron rails, it automatically is in alignment with the drive units on the rig floor. The pump is free to move forward or backward and the belt tightener is installed and operated in conventional manner.

All mud manifolding is mounted in, or on, the single, compartmented

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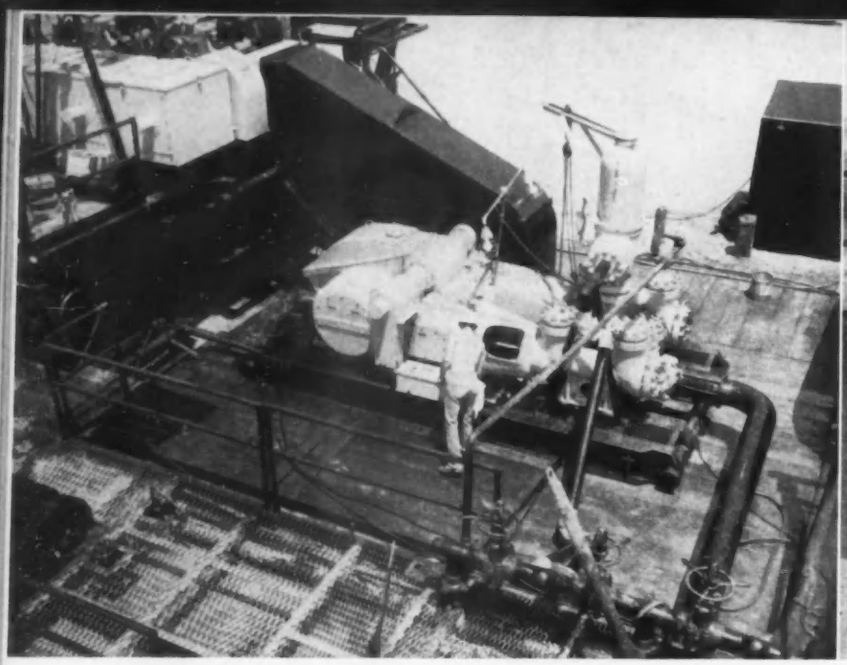


Mud pump position, in relation to drive group, always remain same at every location as result of spacer bar and pin system of locating rig components. Note angle iron guides which prevent pump shifting sideways, yet permit normal adjusting for belt tension.

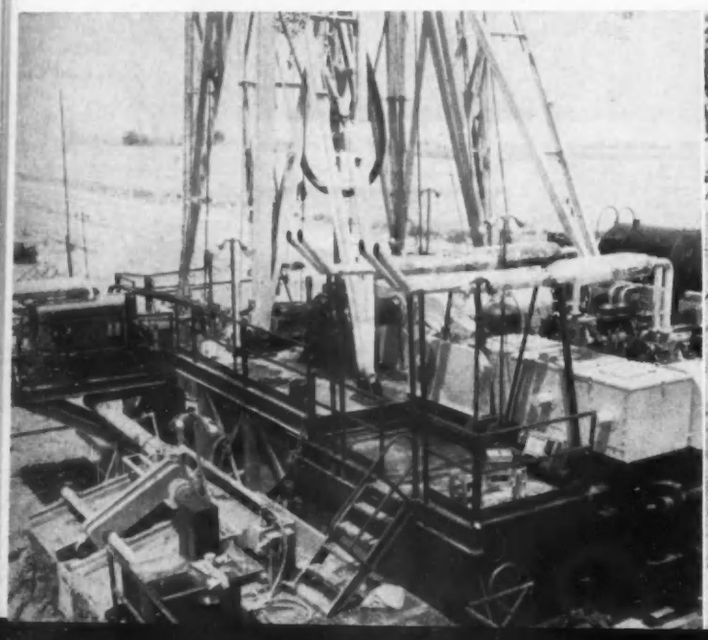
To connect up the mud system requires making up only six unions. Note use of flexible hoses in connecting up mud system. Panels at left are main controls and switches of electrical system. Note spacer bars, right distance, which determine mud stank position relative to sub-base.

steel mud tank. To connect up the mud system between pump and rig requires only the making up of six unions, after which it is ready for operation.

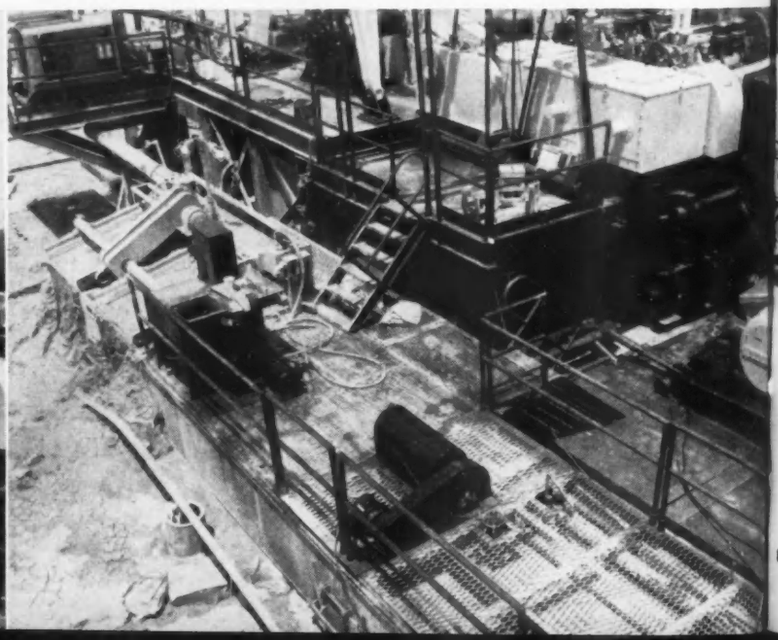
The 250-barrel capacity mud tank is decked over with a heavy grade of expanded metal which permits men to walk on top of it, operate valves, check shakers and other equipment. The two main electric control panels are mounted side by side at the end of the mud tank. The unitized installation containing mud testing equipment and chemical mixing box, the latter equipped with a 5-horsepower electric motor mixing unit, also is located atop the mud tank. Electric mud mixers and agitators are built into the tank and are used most of the time, but mud guns are available if necessary. Over-all length of the tank is 43 feet.

Fresh water is carried in two tanks, one built into each of the two sub-bases. Total water storage is 120 barrels. An electric powered circulating pump, also mounted in one of the sub-bases, delivers water under constant 40-pound pressure to all parts

Neatly kept, ample floor area is evident in this view of rig floor and surrounding equipment. Note manner in which rotary engine, left, is mounted on detachable base bolted to substructure. Expanded metal covering on single mud tank permits easy access to valves, mixer controls and mud testing unit.



Single mud tank, 43 feet long, is decked over with heavy gage expanded metal. Electric motor driven mixer in foreground. Nearer to shaker is unitized chemical mixing box equipped with motor-driven mixing paddles. Atop this is rectangular and mud testing equipment storage box, hinged to lay flat when moving.



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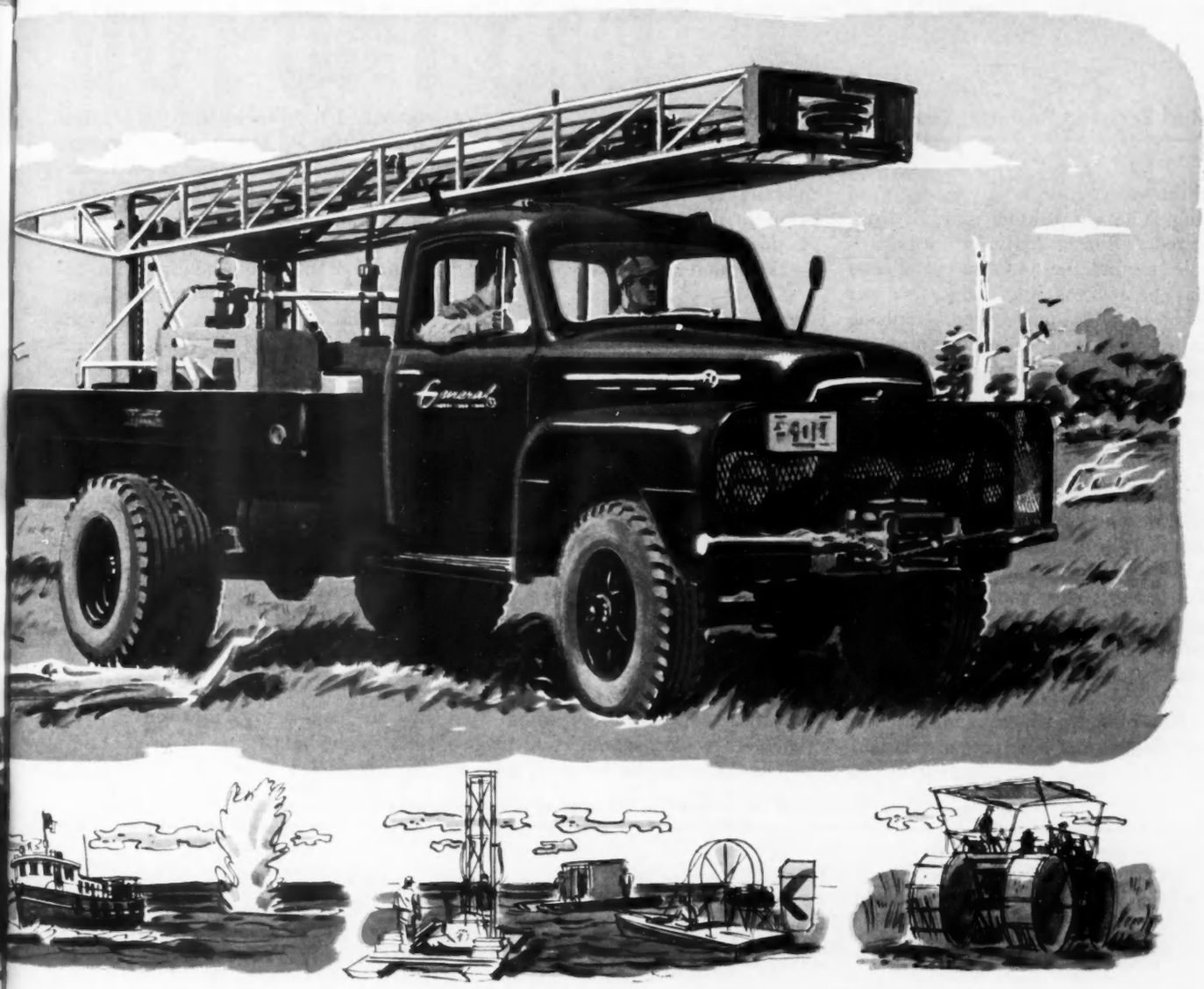

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of the rig; water lines being built into the various rig components. Hydraulic brake circulating water comes from one tank and discharges into the other, a flexible, quick-coupled line keeping levels in the tanks equalized.

Saving rig floor space and requiring little time to rig up or dismantle, the skid-based rotary engine is supported on an outboard platform which, inturn, is bolted to the sub-base. Quickly rigged up or removed, the rig ends of the horizontal platform members drop into slots and the two diagonal braces are bolted to plates welded to the side of the sub-base near ground level.

The drawworks, power units and transmission group are mounted on separate skid bases which, in turn, are supported by structural I-beams spanning the area between the two sub-base units. Under-floor area and head room are ample, permitting maximum accessibility to blowout preventer, cellar area and under-floor fittings.

A factor contributing to faster moves between locations is the pipe rack design. Rack sections are parted at the walk, making it possible, when preparing for a move, to lay pipe down on the rack on but one side of the walk. Then, when moving to the next location, only the remaining empty rack, the walkway and enough drill pipe to spud in and start drilling, are moved. Only after the new well is spudded in, when the rush and pressure of rigging-up is past, is the remainder of the drill pipe, plus the second rack, moved. Since the contractor operates his own trucks, his selection of the time to complete the drill pipe moving operations is somewhat more flexible.

A pair of channel iron slides, attached to the rack side of the rig, permits assembling the mast at pipe rack level; an important factor from the standpoint of both safety and speed of rigging.

Typical moving time, from release on one well to spudding in the next, and assuming a typical field move of from two to five miles, is 12 to 14 hours. No crane is required; all loading being done by the contractor's own pole trucks. —**The End**

Mud Logging Promises Gas Sand Evaluation

Continued from Page 143

of the gas volume in the gas-cut mud plug. The gas volume may, in turn, be reduced to its equivalent at bottom hole temperature and pressure and may be expressed as cubic feet per cubic foot of sand drilled. Applying an estimated or measured porosity, the gas saturation of the sand may be estimated. This process would amount to the ultimate in quantitative information we might hope to derive from rate of discharge data.

The effect of the expanding gas-cut mud on pressure reduction at the bottom of the hole is an aspect of drilling which deserves some clarification at this time. In this connection it is interesting to determine the maximum reduction in bottom-hole mud pressure for the problem we have just solved.

The plug is at its maximum length and the bottom hole pressure has suffered its greatest reduction at the instant of breakthrough. We may compute the approximate magnitude of this reduction at the instant of breakthrough as follows:

$$W_{avg} = \frac{W_{go} + RW_m}{(P_1 - P_2)\,R}\left[(P_1 - P_2) - \frac{P_o}{R}\,ln\,\frac{RP_1 + P_o}{RP_2 + P_o}\right]; \qquad \text{Eq. 35}$$

and for our problem at the instant of breakthrough, we have:

$$W_{avg} = \frac{80{,}025}{160{,}150 \times 1000}\left[160{,}050 - \frac{802{,}160 \times 2.3026}{1000}\,Log_{10}\left(\frac{1000 \times 162{,}210 + 802{,}160}{1000 \times 2160 + 802{,}160}\right)\right]$$

$$W_{avg} = 78.42\ \#/cf.$$

From Column 4, Table 2, at the instant of breakthrough we find that at the top of the gas-cut mud plug the specific weight is 58.35#/cf. and at the bottom is 79.63#/cf. From Equation 35, above, we found that the average specific weight of the gas-cut mud in the plug was 78.42#/cf., or only a little more than 1#/cf. less than that at P_1. Moreover, the average specific weight at the instant of breakthrough is only about 1.6#/cf. less than that of the clean mud, uncut by gas. It is calculated that the maximum reduction in bottom-hole pressure resulting from a plug having the dimensions and quality of that in our problem is only 3234#/ft.^{2} or 22.5#/in.^{2} There are times when a pressure reduction of the magnitude would be critical, but usually it would not since several hundred pounds per square inch differential is normally maintained where this is possible. The results of our analysis are suggestive that, unless abnormal pressures are encountered, the usual volumes of gas-cut mud rising to the surface should not normally be a serious blowout hazard. Combine the expansion of gas-cut mud with any swabbing action by the drill-string, however, and the gas might be a factor in promoting a blowout.

The concluding installment of this article will appear in a coming issue of WORLD OIL.

See Current Outlook, Exploration, Production, International sections for other articles on drilling progress

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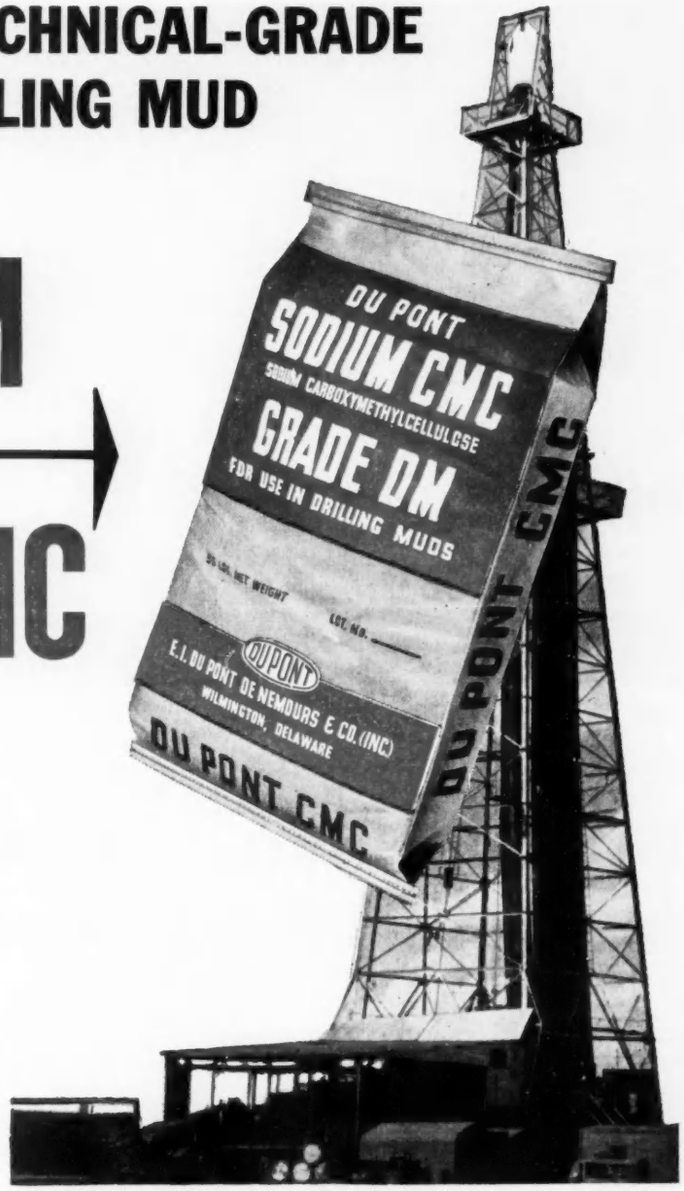

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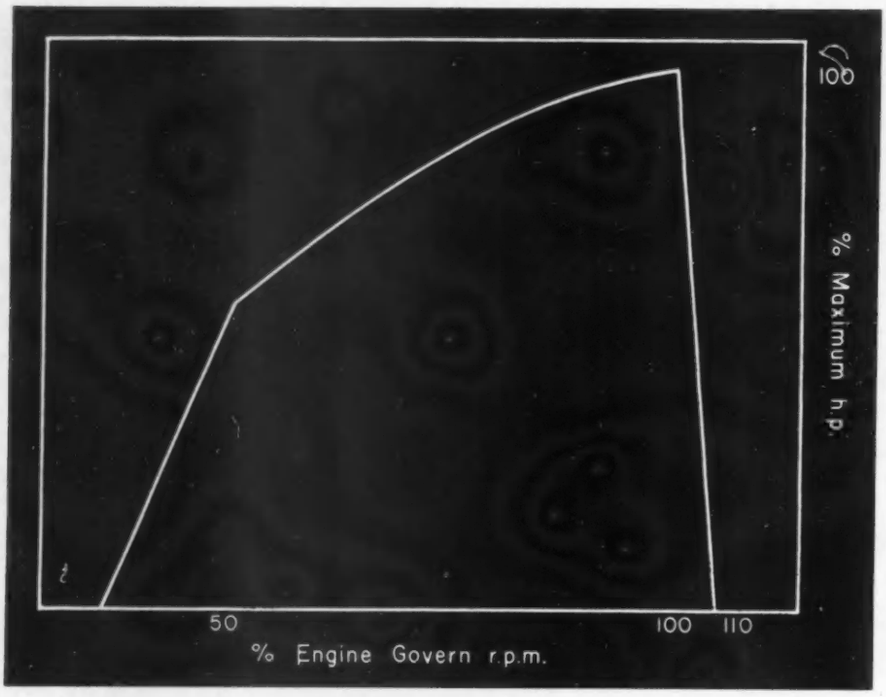


FIGURE 1

Hydraulic Torque Converter In the Mud Pump Drive

Fluid horsepower characteristics can be improved by:

- **Utilization of steam power**
- **Application of the electric drive**
- **Installation of torque converter drive**

By M. H. WOODWARD,
Twin Disc Clutch Company, Tulsa

IT IS THE AIM of engineering everywhere to provide a superior product or service in greater quantity at a lower cost. Because the application of the torque converter to the mud pump is no longer in the province of research or pure science, the subject is treated here fundamentally from the economic viewpoint.

Since Captain Lucas, the Spindletop dome discoverer, drilled the first well with rotary equipment, there have been a number of improvements in the technique. Bits, drilling fluid, drill pipe and joints, drawworks, fishing tools and techniques—all these and many other items have been improved. The mud pump itself has been improved greatly.

Yet with the advent of internal combustion power to the mud pump, its power factor was seriously impaired. No longer was it possible to achieve the broad pressure-speed ratios that the steam pump offered. Because other benefits of the power rig so greatly overshadowed its disadvantages, it rather quickly took over the oil fields. Drillers quickly resigned themselves to lower volumes of fluid during the low pressure part of the hole. They resigned themselves to more frequent liner changes.

Since that time the drilling contractor has been discontent with many things. And his dissatisfaction has brought about the improvements that permit the people to drive 57,595,376 vehicles in this country alone.

He has done a good job. His equipment suppliers have done well with their reactions to his requirements for improvement.

Only recently, however, has there been a general recognition that it is possible to use a given mud pump to supply more fluid horsepower over a greater range of conditions—at a lower initial cost for the power-pump unit.

The slush pump manufacturers have been building good pumps—pumps with greater pressure tolerances, higher speeds, and better wear-life. But they generally have published limitations on these pumps with the thought that the pumps would be used with straight mechanical drives from the engines. Naturally, they want the optimum power absorption point of the pump to coincide with the engine speed at the point of maximum power.

In the typical curve shown in Figure 1 the limitations are apparent.

With a given liner size it is impossible to utilize maximum engine power at any point except at full load at governed speed. Early in the hole the drilling fluid circuit resistance at the maximum available speed is too low to permit more than a fraction of engine rated power to be used. The engine rides the governor.

As drilling fluid circuit resistance increases, the power utilization increases. At smoke point on a diesel, or at 5-inch manifold pressure on a gas engine, the throttle has to be reduced. Speeds are reduced as line resistance increases up to the point of liner change. Engine available power reduces with speed. With this liner size your examination will reveal that maximum continuous rated power was used only for a small part of the operation. The rated capacity of the pump was utilized only for this same short while.

There are at least three apparent methods of improving these fluid horsepower characteristics:

1. Return to Steam
2. Electric Drive
3. Hydraulic Torque Converter Drive

Items one and two will be left for

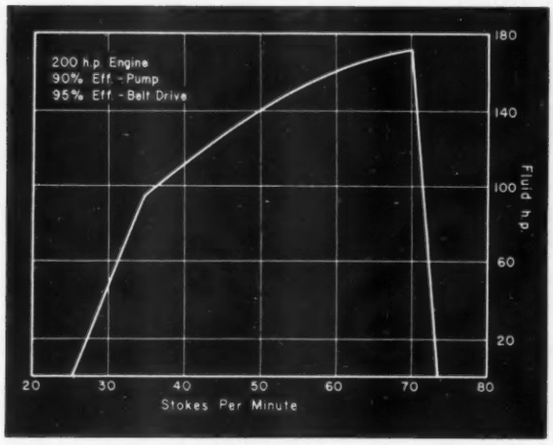


FIGURE 2

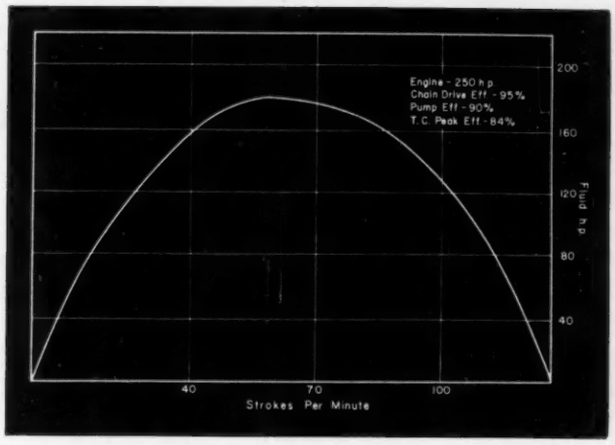


FIGURE 3

the reader's own exploration. Item three will make it possible to provide high fluid horsepower over a broad range of volume and pressure with any given slush pump at a lower power-pump cost.

Example—Mechanical Drive

Required: By past standards a 200 hp pump is indicated. With a straight mechanical drive this would be driven by an engine of 200 hp continuous duty rating.

Assumed: Pump rated at 70 strokes per minute
V-Belt efficiency loss—5 percent
Pump reduction gear loss—5 percent
Hydraulic efficiency loss—5 percent
Over-all efficiency—85 percent.

Result: (See Figure 2).

Observations: Maximum fluid hp (171 hp) can be achieved only at 70 spm with the throttle open and the engine barely below the governor.

Early in the drilling hole the fluid pressure at maximum volume will be less than half the maximum available pressure at 70 spm. So fluid hp is less than half of the 171 hp available—less than 85 hp.

As the hole deepens, resistance rises, and the operating point moves to the left on the curve above. It passes through the peak hp point, then reduces with the spm. At 50 spm approximately 140 hp is available.

Cost: In this size range, the engine cost equals approximately two-thirds of the pump cost.

Example—Torque Converter Drive

Required: By past standards a 200-hp pump is indicated. To achieve a lower initial cost per usable fluid horsepower hour through the drilling cycle, use an engine with a continuous duty rating of 250 hp with a torque converter. This practice is feasible because the torque converter permits the mud pump to operate successfully at lower safety margin, due to the shock absorbing characteristics of the drive.

Assumed: 85.6 percent efficiency from converter output shaft to fluid hp.

Result: (See Figure 3).

Observations: With this power package, there is no point at which fluid hp is below that of the mechanical job shown in Figure 2. At 50 spm about 36 additional hp is shown over the mechanical drive. At surface, fluid power is practically doubled.

Through the work cycle on any given liner, the fluid hp hours are greatly increased with a resultant decrease in drilling time.

Cost: The 25 percent increase in engine size plus torque converter bring the cost of the power unit to approximately the cost of the pump. This broad increase in fluid hp utility, then, may be had for about 17 percent additional total cost in the power-pump package.

Notes. "Dynamic Principles of Mud Pump Operating Using Torque Converter Drive" by Gene Shiels is an excellent report of the comprehensive tests of pumps in parallel and series operation conducted in 1954. Shiels concludes that the torque converter drive of slush pumps singly, in parallel, and in series is not only practical but also serves to reduce the destructive discharge pressure variations which are inherent in reciprocating pumps.

In addition to the reduction in initial cost of available fluid horsepower, the torque converter offers other advantages to the independently driven mud pump.

1. The ability of the converter to absorb cyclic peaks permits the use of chain drive. This, as compared to a V-Belt drive, reduces the WR^2 by 90 percent, thus permitting the converter to absorb even more of the cyclic peaks. This is apparent in reduced noise level in the pump and in reduced "kick" in the swivel hose.

   It seems reasonable that such improved smoothness, evident at both power end and fluid end, must result in lowered down-time and repair costs at both ends of the pump.

2. The chain drive permits shorter shaft centers for more compactness and easier hauling.

While fuel cost per hour will increase it does not necessarily follow that the fluid hp per hour fuel cost will rise, although it will in many cases rise a small amount. The improvement in engine operating compensates, or tends to compensate, for the converter efficiency loss.

In all cases, the pump manufacturer should be consulted before the application of the converter drive. Virtually all pump manufacturers will approve higher spm with the low-inertia torque converter drive, provided that cavitation is avoided. Some will permit higher pressure loadings at reduced spm. The converter permits such utilization.

—The End

What's happening to

Turbodrill Development?

POINT 1—The Russians say turbodrill is a standard oil field tool in their country.

POINT 2—Endless research and successful field testing has been conducted on the West Coast.

POINT 3—Isn't industry overooking a good thing by not accelerating development?

By W. R. POSTLEWAITE
Standard Oil Company of California,
San Francisco

THE PIONEERING work in this country to develop a successful mud-powered turbodrill was first undertaken by Standard Oil Company of California more than 30 years ago. C. C. Sharpenberg of that company obtained Patent 1,482,702 in 1924, and in 1926 one of his first turbodrill models was used for experimental drilling in the Tupman property in Elk Hill, Calif.

These early turbo designs, however, employed bearing seals on the shafts which invariably leaked and cut out as a result of the abrasive action of the drilling fluid used as the driving medium. Although these tools were not sufficiently durable to be commercially usable, they demonstrated the general mechanical possibilities of this device. Consequently, in 1935 arrangements were made with a manufacturer to take over the turbodrill design work and to cooperate with Standard of California to develop this tool further. This soon resulted in very definite and substantial progress, both in the design and in the field usages, although there was a serious interruption involving a long dormant period during the years of World War II when all work on the turbo had to be entirely suspended.

Justification for initiating and pursuing this development has been numerous economic and operating advantages promised by the turbodrill over the conventional rotary system. It was estimated, for example, during World War II, on the basis that the penetrating rates would be equal for the two methods, that the drilling cost with a turbo would be $6000 to $10,000 less per well than with the usual rotary equipment. Included in this cost saving was depreciation on the drilling equipment which was estimated to cost about $40,000 less per rig with the turbodrill.

As explained later, one of the prime advantages of the turbo over the rotary is its stationary drill pipe and the obviously much lighter duty imposed on this pipe as a result. Furthermore, this is a very significant feature since drill pipe constitutes a pertinent expense item in drilling. For example, the average annual replacement expense for drill pipe in Standard of California's operations, in the five years of 1936-1940, was 43 percent of the total expense for replacement of all drilling equipment. Drill-pipe cost during this period was $300,400 per year, compared to $397,000 per year for all other drilling equipment combined.

It may be of interest to review some of the reasons why the turbodrill is expected to operate at a lower cost than conventional equipment. It must be understood that, particularly in the deeper wells, nearly all the power now applied by the rotary table at the surface is wasted in friction between the pipe and the mud circulating fluid, and against the side of the hole, and that only a small fraction, perhaps 10 percent, is actually applied effectively to the bit. It must be further realized that with the conventional rotary system, nearly all the power applied to the circulating fluid by the pumps is expended in friction and that usually only a minor fraction serves any useful purpose at the bottom of the hole.

As an example, it may be indicated that if the mud pumps put up 500 pounds per square inch pressure, perhaps 470 psi are used in overcoming friction, and only 30 psi in jet action at the bit. Various experiments have likewise indicated that in deep holes from 10 to 25 horsepower is required to turn the bit, although the rotary drive may have to deliver several hundred horsepower. The friction of the circulating fluid cannot be reduced beyond a certain point for this would require the use of a larger rotary drill pipe, which would not only be expensive, but would further

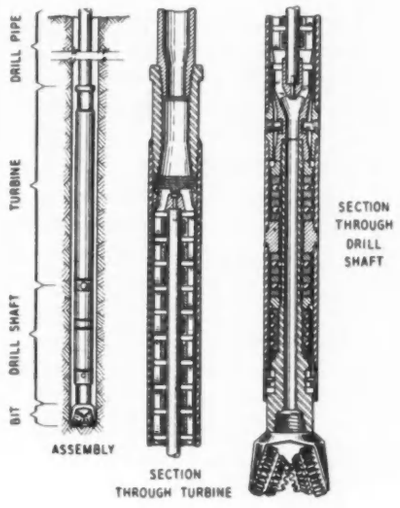


FIGURE 1 — Assembly and sections through multistage turbodrill.

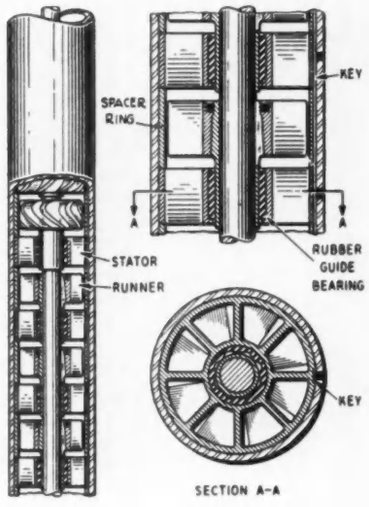


FIGURE 2—Views of turbine runners, stators, and rubber guide bearings.

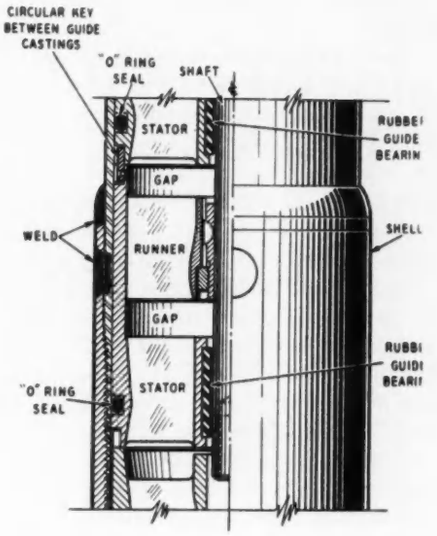


FIGURE 3—Detail of 5-inch turbo with O-ring seals and disk keys between stator stages.

increase the amount of power required to turn the string.

The rotary drill pipe is subjected to considerable wear from friction against the side of the hole, and from heavy loads, largely due to its great flexibility which permits it to wind up and violently unwind as the resistance changes.

With the turbodrill the string of drill pipe must, of course, still take the actual net effort applied to the bit, even with the pipe stationary, but as this torque may be on the order of but 10 percent of the effort applied at the top with conventional equipment, the drastic reduction in shock loads, reverse stress, and friction load should lighten the duty on the drill pipe tremendously.

Lighter drill pipe and simpler tool joints can be used, promising much longer pipe life and greater freedom from failure at a considerable saving in cost, and it also becomes particable to use pipe of larger diameter, thus minimizing the pressure required on the circulating pumps. Thus, although the mechanical efficiency of the turbine is only on the order of 50 percent and the mud pressure may have to be increased several hundred pounds to operate the turbine, the over-all pumping power required should, with a properly designed and balanced installation, probably be less or no more than with conventional equipment. Protective collars on the pipe likewise would not be needed. Incidentally, the turbodrill appears to be very well suited to the use of internal-combustion engines as a source of power.

The turbodrill inherently turns faster than the rotary, and by proper coordination of bit weight and speed, made feasible by an effective speed indicator, the abundance of turbine power available right at the hole bottom has always held the prospect of increasing drilling rates materially. The automatic limitation of maximum stalling torque, characteristic of this reaction type of mud turbine, would also be an advantage in some very deep drilling.

TURBODRILL DESIGNS

It was with the foregoing objectives in mind that substantial sums have been invested in the development of the turbodrill. Rapid advances were made in the designs of turbines ranging in diameter from 6 to 11-inch until interrupted by the war in 1941. The long flexible multistage turbine-runner shaft, originally guided only by bearings at each end, had whipped badly in the earlier Sharpenberg models, and was replaced by the present improved design having a separate radial guide bearing at each individual turbine stage. This and other pertinent features are shown in the drawings of Figures 1, 2, and 3.

These turbine-runner bearings are of the conventional fluted rubber sleeve type used on marine propeller shafts, and on the rotor shafts of sand dredges. In the turbodrill they run directly in the drilling fluid which serves as the lubricant. This multiple-bearing arrangement completely stabilizes the long turbine shaft and permits using any number of stages in the turbine assembly to secure any amount of power desired at any reasonable number of revolutions per minute, and rate of mud circulation.

For example, as many as 50 stages have been built in 9⅝-inch-OD turbines although 30 or even 20 stages have proven adequate as regards torque and power requirements for most of the drilling. Methods of assembly have been worked out which permit worn turbine parts to be replaced expeditiously, and permit the maintenance of proper axial clearance of the runners at all times.

Another new design feature evolved after exhaustive laboratory and field tests, was to expose the turbine thrust bearings, carried by the drill shaft on the lower end, so they too would not require fluid seals, and could operate directly to the drilling mud. It had been found virtually impossible to devise a practical shaft seal to effectively exclude the mud from oil-lubricated bearings, whereas, by taking reasonable precautions in desanding the drilling mud, the abrasion of the large-diameter hardened ball thrust and guide bearings used on the lower end of the turbine assembly, was found to be acceptable and a

reasonable compromise in favor of simplicity.

These ball thrust bearings on the drill shaft, although subject to wear in this service, were improved to the point where, with the loadings used up to 1941, they operated for more than 100 hours without breakage, and were replaceable without undue expense or lost time. Subsequent tests at heavier thrust loads have revealed the need to either provide greater bearing capacity or to balance hydraulically part of the thrust of the turbine. Designs have been made to cover both of these alternates.

Numerous other significant mechanical features were gradually evolved which have contributed to the present status of the turbo design. Some of these are outlined below.

Reaction Turbine Details. One basic principle which has enabled this reaction type of turbine to operate so successfully on abrasive-laden drilling mud with little maintenance, is the careful proportioning of the internal fluid passages as large as possible so as to minimize the jetting velocity of the fluid, and so reduce the abrasion. The stationary vaned guide castings, and the bladed runners of each stage, are made of conventional nickel iron, but with the low mud velocities involved here, the durability of these parts has been very satisfactory.

Some mud-operated turbines designed by others have in the past employed high mud velocities through the blading, and consequently have suffered heavy maintenance and wear. The turbine constructed as shown in Figures 1 and 2, has repeatedly demonstrated that a multistage assembly, involving lengths up to 35 or more feet, with the runners so well guided at each stage, is a practical and durable power unit for drilling service.

Rubber Guide Bearings. The turbine runners are clamped securely onto the turbine shaft by the unique tapered and split-collet hub assembly shown in Figure 2. To prevent wear of the long central runner shaft in the rubber guide bearings, the lower sleeve end of the replaceable runner hub clamp is used as the journal for the next lower guide bearing. The outside of this journal section is protected by a hard industrial chrome plating which runs very well in the fluted-rubber guide bearings lubricated by the drilling fluid.

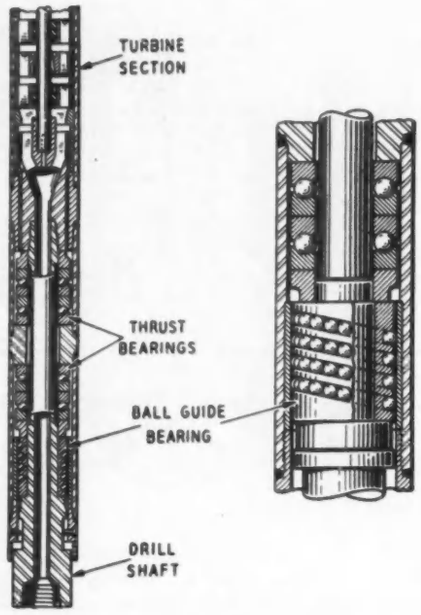


FIGURE 4—Improved radial guide ball bearing and dual ball thrust for turbodrill.

The axial flutes or channels in these rubbers allow fluid to circulate freely, due to the pressure differential at each stage, and when sand particles are engaged between the mating surfaces the flexibility of the rubber enables the particles to roll circumferentially to the next axial flute where they are released and washed on through.

Outer Spacing Rings Eliminated. Another pertinent improvement in the turbine design, which reduced the number of girth joints between the abutting stator guide castings by 50 percent, was the elimination of the separate outer spacer rings of Figure 2. As shown in Figure 1 the stationary guide-vane castings now have double length extension skirts which completely shroud the adjacent runner castings.

This presents a continuous sleeve of hard nickel iron right at the bottom of the runner wheel where the exit velocity of the mud is high, and where erosion otherwise tends to occur at this point.

Drilling with the turbo under high differential mud pressures of 800 to 900 psi disclosed that the necessary degree of sealing or tightness could not be secured at the many abutting end joints between the stator castings. Short-circuiting of mud through some of these tightly clamped machined joints allowed small quantities of mud to flow between the outside of these castings and the outer housing of the turbine, and this by-passed mud eroded the castings as well as the soft outer steel shell. Consequently, the 30-foot long key of Figure 2 has since been dispensed with in favor of a novel circular disk type of key which locks each individual stator casting to the next adjoining casting. This permits incorporating conventional rubber O-ring seals in the design as shown in Figure 3, and makes a rapid and leak-proof assembly.

Drill Shaft. As shown in Figure 1, the drill shaft with its several bearings is now a completely separate subassembly from the turbine proper, and the embodiment indicated has but one radial guide bearing situated at the bottom end. A further modification of this radial ball guide bearing is shown in Figure 4.

The peculiar inclined ball races cause the bearing balls to move axially at the same time they rotate around the shaft. This reduces the concentrated wear on the flater outer race, as occurred when using conventional inner races having the grooves at the usual 90-degree angle with the turbine axis. Additional improvements in this shaft guide bearing are discussed further on in this paper.

EXPERIMENTAL DRILLING

Most of the design features described thus far were evolved in the active six-year development period just prior to 1941. By that time the turbodrills in the 9- and 11-inch sizes had been used to bore five oil wells totaling about 11,000 feet.

In most of the oilwell drilling, which was done in Greeley, and in the Midway Sunset field in Southern California, the penetrating rate was roughly comparable to that obtainable with the rotary at that time in the surrounding areas, and one of the turbodrills completed all of the 3000-foot depth without any major maintenance. In a few instances the tubo's on-bottom drilling time was even somewhat faster than the rotary for the depths involved, none of which exceeded about 3200 feet.

SPEED INDICATOR

In May, 1950, the turbodrill development program was resumed, using

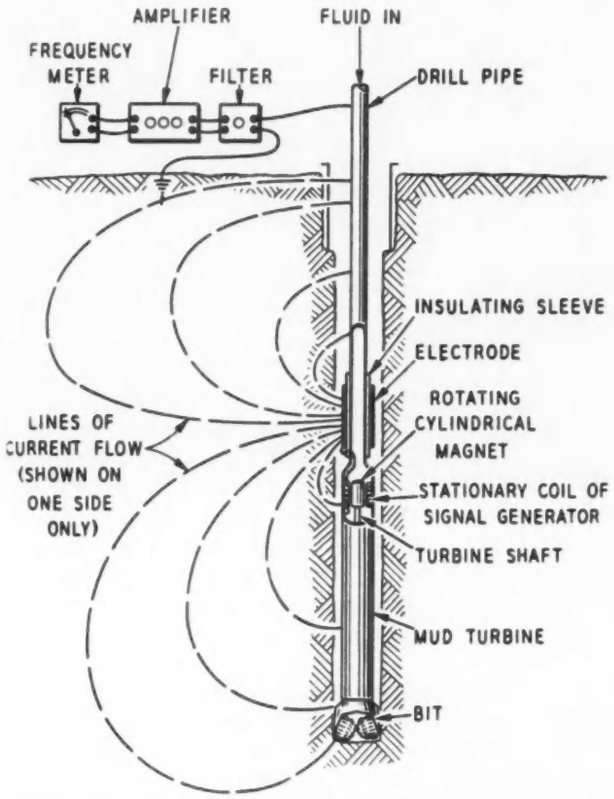


FIGURE 5—Schematic drawing of electric bottom-hole speed indicator and related surface instrumentation.

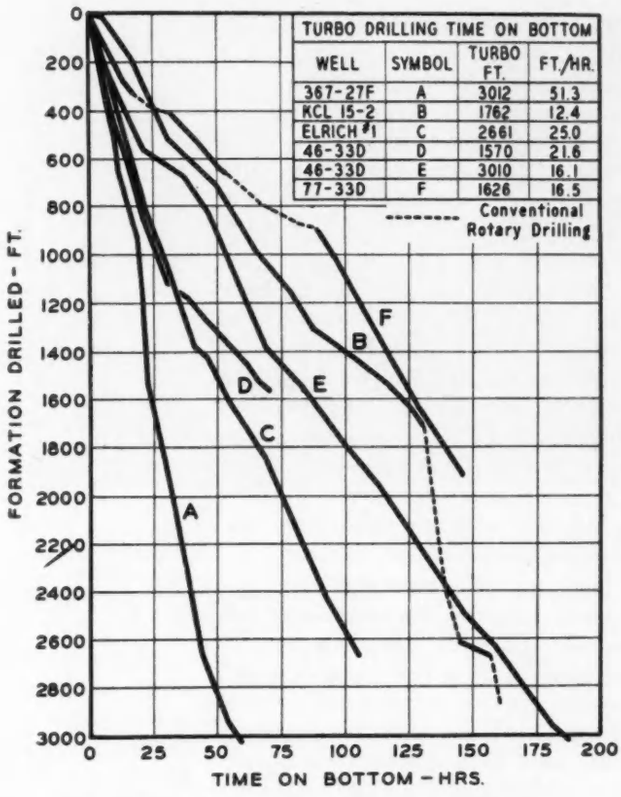


FIGURE 6—Experimental turbodrilling in California.

the prewar turbo designs, but with the addition of an electric speed indicator incorporated in the upper end of the turbine housing.

All of the previous field experience with the turbodrill demonstrated the need for an effective speed indicator. The turbine speed indicator designed for this purpose comprises an alternating-current generator having a long alnico permanent-magnet rotor coupled directly to the top end of the turbine shaft. The coaxial stator winding is hermetically sealed in a welded stainless-steel case to exclude the mud, and its electrical output is connected between the magnetic housing of the down-hole equipment, and a long upper insulated electrode positioned immediately above the generator.

This electrode is a piece of 6-inch pipe coated with rubber on the outside. A stainless-steel jacket encases this rubber coating thus comprising the insulated electrode used to initiate the propagation of electrical impulses from the well bottom to the surface.

The rotation of the turbine-driven generator sets up alternating-current distribution in the ground, and the frequency of this current flow corresponds to the rate of turbine rotation. Since the earth may here be considered as a semi-infinite conducting medium, the electrical current distribution set up in the ground by the generator extends outward in all directions from the down-hole equipment point, the current density decreasing as the distance from the source increases. A minute current flows along the surface of the earth in the vicinity of the top of the well bore. This current is detected by employing two potential measuring electrodes, one of which is connected to the top of the drill pipe, and the other to the earth at some distance away.

The small alternating potential existing between these two electrodes results from the ohmic effect of the earth between the electrodes, and the current flow established by the down-hole generator. This potential, which is but a fraction of a millivolt, is amplified by suitable surface instruments which also measure the frequency. A calibrated gage positioned near the driller provides a continuous indication of the bit speed in the bottom of the hole. The general arrangement and the functioning of the entire system is illustrated schematically in Figure 5.

EXPERIENCE WITH TURBODRILLS

The experience to date in drilling six wells with the turbodrills totals about 14,000 feet and the decided improvement in drilling rate in the last test is illustrated in Figure 6, where the performance in well 367-27-F may be compared with the earlier and slower prewar drilling. The fact that the net penetrating rate in even the latter well is considerably less than can now be achieved by the present-day rotary drills in this area, is an irrelevant observation since the object in virtually all this turbo development work has been to explore some of the various design features or operating phases of the turbo drills, rather than simply to secure maximum rate of penetration.

In the May, 1950, test in Well 367-27-F, the mud flow through the turbine was tried at almost twice the rate previously used. As had been anticipated, thrust-bearing breakage

was experienced in drilling this well due to heavy hydraulic thrust, but pertinent information was secured on bit performance at turbine speeds up to 1200 revolutions per minute. Mud flow of 875 gallons per minute and 1100 psi was used here, with two engine-driven mud pumps operating in parallel.

In recent years well diameters have been considerably reduced, and in drilling the last well with the 9⅝-inch-diameter turbo it was here necessary to bore a 12¼-inch-diameter hole to provide the proper side clearance at the turbine barrel. Normally a 10⅝-inch-diameter hole would now be drilled with the rotary to take 7-inch-diameter casing.

Over the period of years that has elapsed since the 9⅝-inch turbo was correct, this size has since become economically obsolete and consequently, in view of the smaller hole and casing sizes that are currently being used in California, turbo designs should now have an outside diameter not larger than 8⅝ inches. Meanwhile smaller diameter turbines in several sizes down to 5½-inch have been designed, and their hydraulic efficiencies have been improved over earlier models as substantiated by additional laboratory tests.

OTHER PROBLEMS AND REMEDIES

The great progress made to date in this development of the turbodrill has revealed operational and mechanical problems, but solutions to most of these have been devised as the need has arisen. Some aspects which would deserve attention in future work on this subject will be discussed.

Thrust Bearings. The experience to date indicates that heavy thrust loads, on the order of 20,000 to 30,000 pounds in the 9-inch turbine, due to high hydraulic pressure differential across the unit, can best be carried by a combination of the hydraulic balancing piston shown in U. S. Patent 2,592,519, and the multiple-collar rubber thrust bearing illustrated and mentioned in U. S. Patent 2,613,917.

The high rubbing velocity suited to these rubber bearings is characteristic of the turbo, and drilling mud is a good lubricant for this service. Thrust bearings employing as many as 27 rubber-faced thrust collars have been designed for the turbodrill.

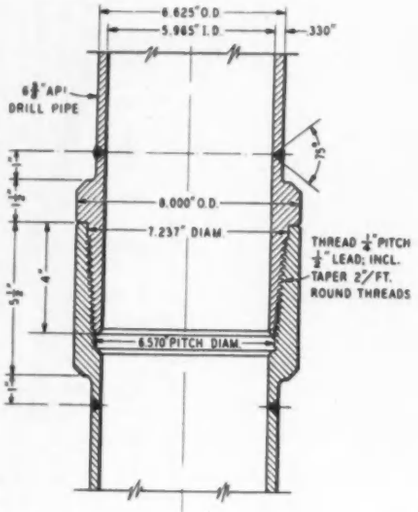


FIGURE 7—Special design of six-inch tool joint with full bore unobstructed passage for high mud flow needed by turbo.

Alternate designs also have been made of "three-stage" ball bearings, which would divide the thrust load evenly between three separate tandem bearing assemblies by means of suitably resilient cushion mounts. Bearing balls similar to those developed for operating in drilling mud on cone bits would be very well suited for thrust service on the turbodrill where the loads are not as severe as those commonly imposed on the bearings in cone drilling bits.

Radial Guide Bearing on Drill Shaft. In view of the marked success of the many rubber guide bearings already in use on the turbine rotor shaft, and the large diameter and long length that could be used in a rubber sleeve bearing for the radial loads on the drill shaft at the bottom end of the turbine, a more serviceable and more durable bearing made of rubber should be substituted here in place of the present radial ball bearing.

In addition to providing cushioning action, such a rubber sleeve bearing (as well as the proposed rubber thrust bearing), would be relatively unaffected by normal amounts of sand in the drilling mud, and desanding of the stream probably could be dispensed with by thus eliminating the last of the steel ball bearings.

Bit Wear. Since ordinary drilling bits now available are known to be well suited to the conventional 200 to 250-rpm drilling speed, a slow-speed turbine, with hydraulic characteristics enabling it to turn at this lower rate, should be very appropriate. Designs for a 9-inch-diameter turbine of this type already have been explored.

Excessive side wear of the legs of the bits when drilling with the standard high-speed turbine, evidently has been due to heavily over-loading the mud stream at this point with the bit cuttings. The high speed of rotation (600 to 900 rpm or higher) has not been accompanied by a corresponding increase in circulating rate to remove the cuttings properly. Examinations of the bits show clearly that the cuttings tend to pile up and bind around the bit to cause such heavy side leg wear. The low-speed turbine with its higher flow rate (850 to 1150 gpm) should give a more balanced design which would jet the cuttings away from the bit.

Speed Indicator. Some additional test work is needed with the electronic equipment used with the new speed indicator. The initial tests of this device were interrupted prematurely when the terminal of the generator was accidently broken on the trial run, and consequently this device has not been properly proven below about 1200 feet.

Straight Hole Drilling. All the turbodrilling to date has employed no significant amount of drill collars, and no drilling at all has been done with any drill collars positioned below the turbine. There has been some evidence at times that drilling with the turbo results in a crooked hole, and it has long been contended that a heavy drill collar would help remedy this situation.

Positioning the drill collar below the turbine would provide very desirable flywheel and plumb-bob effects, and the net downward pressure on the thrust bearings should also thereby be stabilized. The violence of the bit reactions transmitted to the turbine should also be lessened with this arrangement.

Special Tool Joints. The use of large diameter lightweight drill pipe, and the special full-bore tool joint of the type illustrated in Figure 7, offer obvious advantages and should be used with any improved turbodrill design.

ACKNOWLEDGMENT

This paper was presented at the ASME Petroleum Mechanical Engineering Conference in New Orleans, September, 1955.

How to Light a Rig

It will pay for itself in:

- **Reduced accidents**
- **Improved efficiency of workers**
- **Improved morale**

By H. L. LOGAN, Holophane Company, New York City

POOR ILLUMINATION is a direct or contributing cause of many accidents or near-accidents that occur at night on the drilling rig.[1]

Better rig illumination will more than pay for itself

- by reducing accidents,
- by improving the efficiency of workers, and
- by improving the workers' morale.

There is no disagreement on the need for proper lighting, on the benefits that would follow and on the proposition that the cost would be offset by tangible savings.

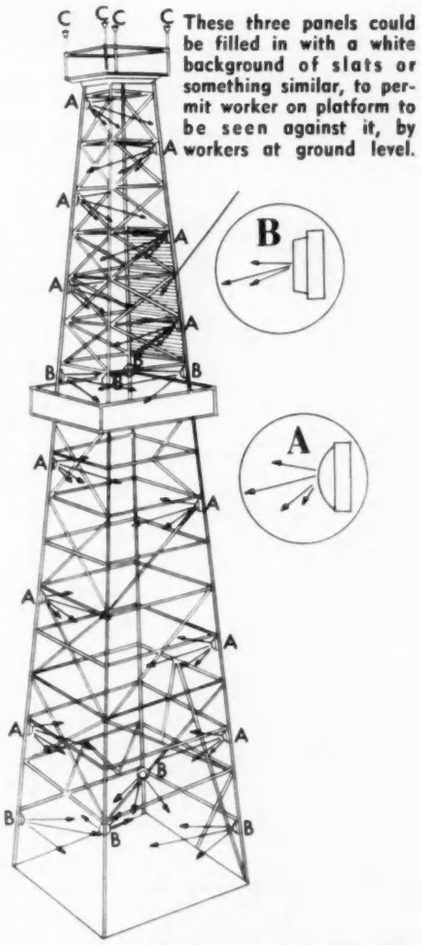
The question remaining is "How?"

In analyzing the visual requirements they come down to this:

1. The workers on the derrick floor and the workers on the fourble board above should have adequate illumination to do all their tasks safely and quickly.
2. Both the workers below and the workers above should have clear two-way vision; that is, they should be able to see each other and what each is doing with certainty.

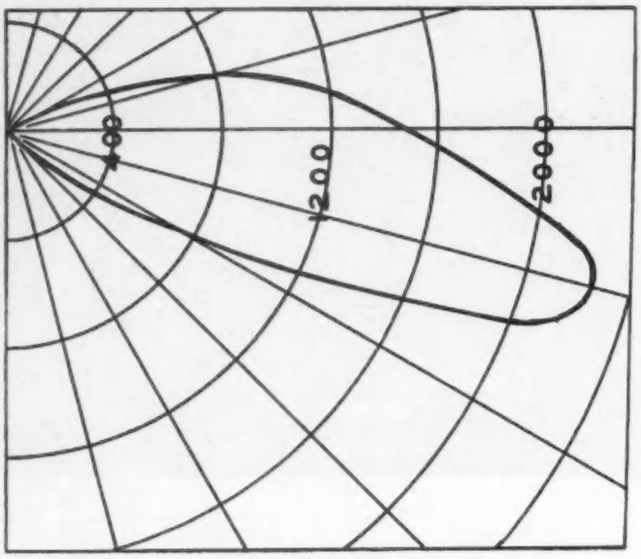
Figure 1 shows a drawing of a conventional type rig with an arrangement of special lights designed to accomplish this. The problem lies in the fact that the lights have to be in the fields of view of the workers and so will interfere with the clear vision required, unless specially designed and specially located. Both on the derrick floor and on the fourble board above, activity is centered around the drill handling.

On the derrick floor a light installed at each corner of the derrick, sufficiently above the workers to be away from their line of sight and aimed across the diagonal of the derrick and having a downwardly inclined beam (20 degrees below the horizontal) with a lateral spread at half candlepower of 50 degrees, would light the rotary table all around without interfering shadows. These lights would

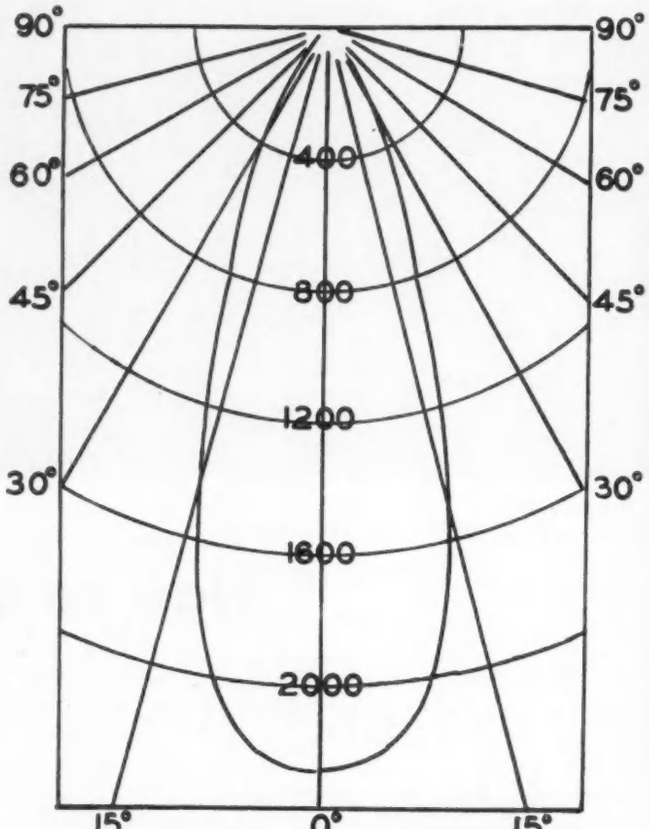


These three panels could be filled in with a white background of slats or something similar, to permit worker on platform to be seen against it, by workers at ground level.

THE EQUIPMENT SUGGESTED SENDS OUT LIGHT MAINLY IN A HORIZONTAL DIRECTION, PERMITTING WORKERS TO LOOK THROUGH IT INSTEAD OF INTO IT.

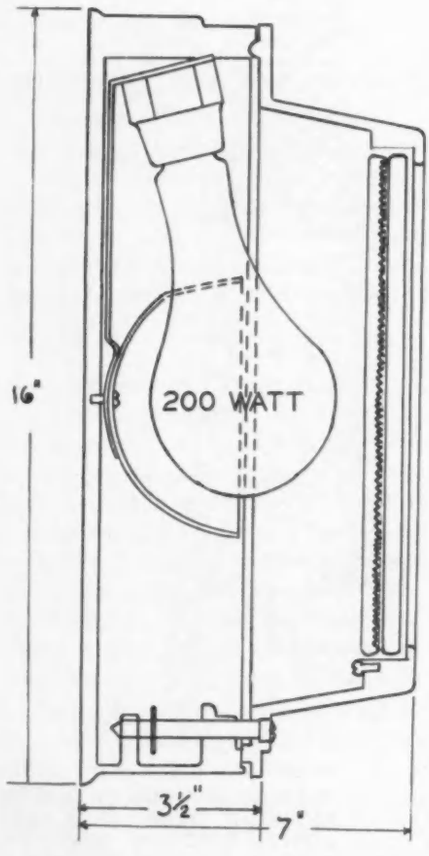


VERTICAL DISTRIBUTION



LATERAL DISTRIBUTION

FIGURE 2—Section and distribution through horizontal and vertical planes of equipment for use in lighting derrick floor and fourble board levels.



also take care of the draw works and all other equipment on the derrick floor.

The same arrangement is required at the fourble board level to light the elevator operation. A picture of the type of light required, a section through it, and its photometric distribution through both vertical and horizontal planes is given in Figure 2.

To ensure two-way vision between derrick floor and fourble board level, while at the same time illuminating the drill pipe continuously, it is desirable for the light to criss-cross the derrick horizontally at all levels with no light going vertically up or down the rig. If this could be done it would be possible for the derrick floor workers to look up at the fourble board station without encountering any glare from the rig lights and for the worker above to look down at the derrick floor without glare. In both positions the workers would look *through* the beams, which would be invisible in the air, although the lighted structure of the derrick, the stacked pipe, the drill pipe and all the mechanism would stand out in sharp clarity.

There is no available equipment known that will do exactly this, but a very close approach can be made to this ideal specification as can be seen by examining the photometric distribution curves in Figures 2 and 3 which show the performance of the lights suggested for the drill floor and fourble levels, and for the rig interior between these levels, and between the fourble board and the crows nest.

The vertical distribution of the lighting unit illustrated in Figure 2 shows no light vertically up or down (at 0 degrees) and it does not become appreciable until 60 degrees from the vertical above the unit, and 45 degrees from the vertical below the unit. With the unit illustrated in Figure 3 (for derrick lighting between and above operating levels) these angles become 45 degrees above the unit and 7.5 degrees below the unit. However, at this latter angle, which is close to the vertical, the candlepower is only 200; and the lines of upward sight would be from 10 to 20 degrees away from the units. At these angles from the lines of sight the glare effect of the rig lights would be reduced from 25 to 50 percent depending upon posi-

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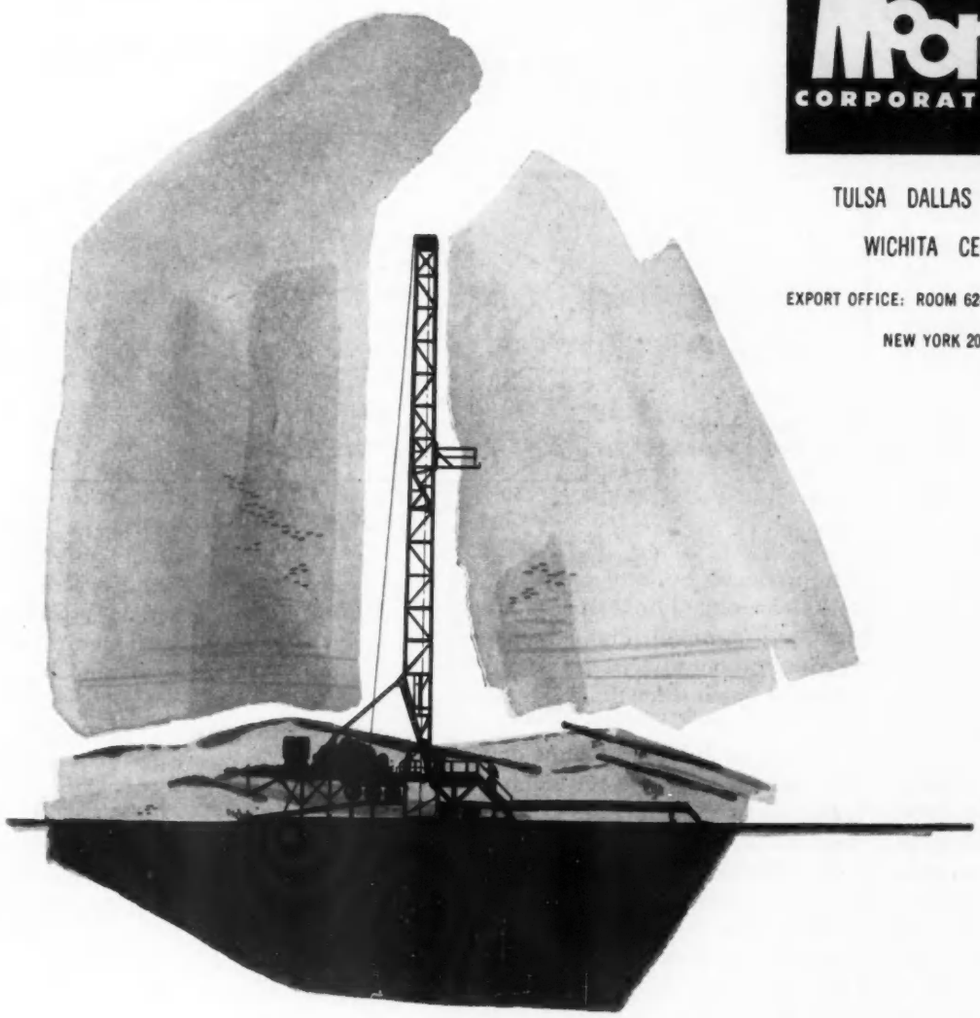


manufacturers of drilling structures, substructures, safety platforms, stairways, ramps, pipe racks, engine foundations, steel floor gratings, pumping units

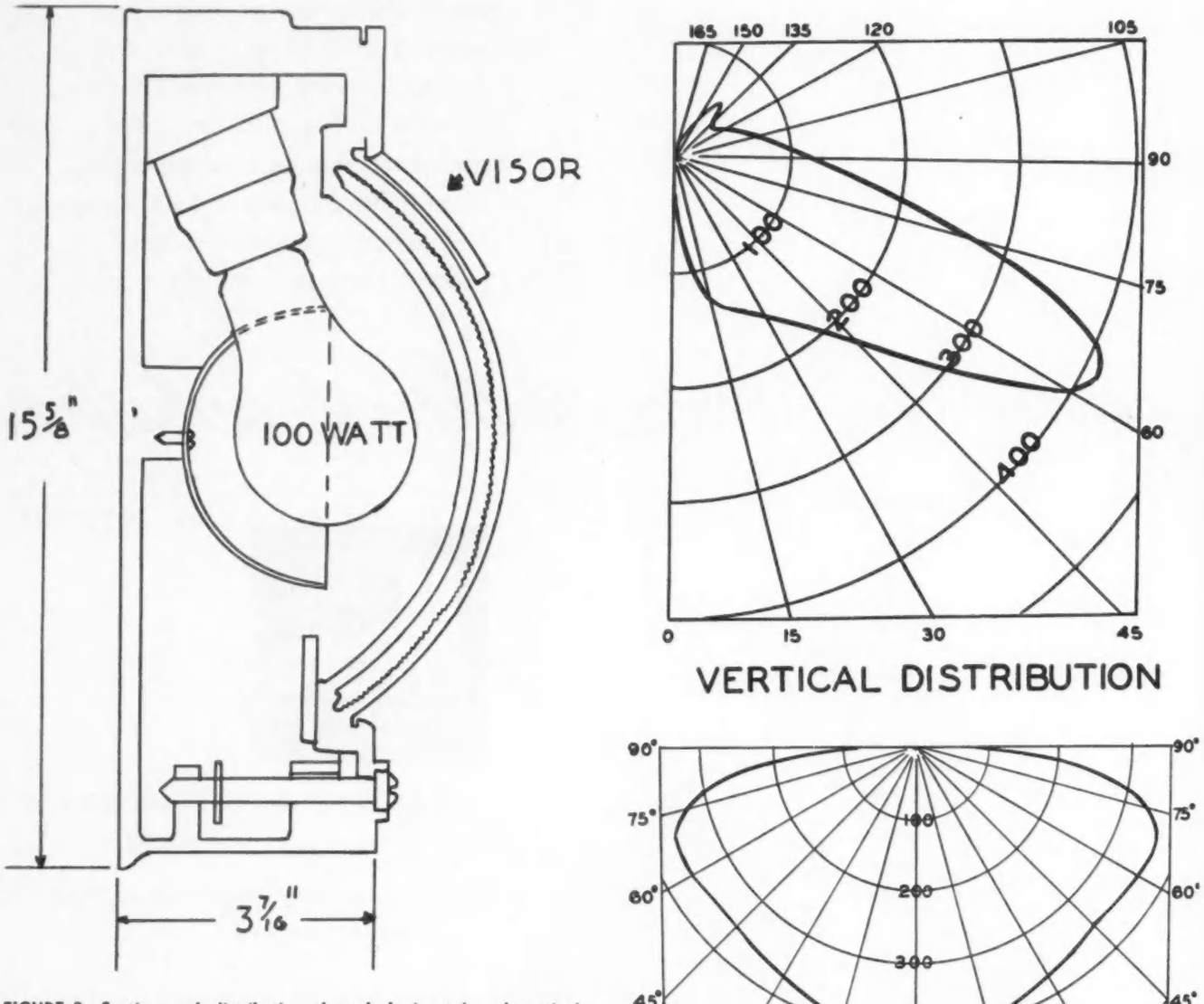


FIGURE 3—Section and distribution through horizontal and vertical planes of equipment for use between derrick floor and fourble board, and between fourble board and crow's nest.

tion on derrick floor of observer.

In short, the operator at the fourble board level could look down without encountering any glare, while the operators on the derrick floor looking upwards might experience some mild glare. This glare would be considerably less than they experience looking up between strings of bare lights; and its effect would be reduced still more if the fourble board worker, as seen from below, appeared silhouetted against a light background, as indicated in Figure 1. The three panels to his rear above him are shown closed in with white-painted slats or something similar mounted on removable frames and clamped into place.

The illumination available with which to see derrick members and equipment would be roughly six times that produced by bare lamps at the same locations. These lights would also "spill" ground illumination over an area with a radius of 200 feet from the rig of about three times full moonlight.

A total of 8 200-watt units and 12 100-watt units, plus 4 100 lights (see Figure 4) at the crows nest, would be required or a total of 3000 watts.

The derrick lights could be clamped onto the derrick members for quick removal. The equipment suggested is heavy-duty, weather-proof, and could stand rough handling. The glass lenses could be protected by heavy wire grids similar to those used to protect gymnasium lights.

REFERENCE

[1] 1950 Report of the "Committee on Rig Lighting for the Oilwell Drilling Industry" AAODC.

—The End

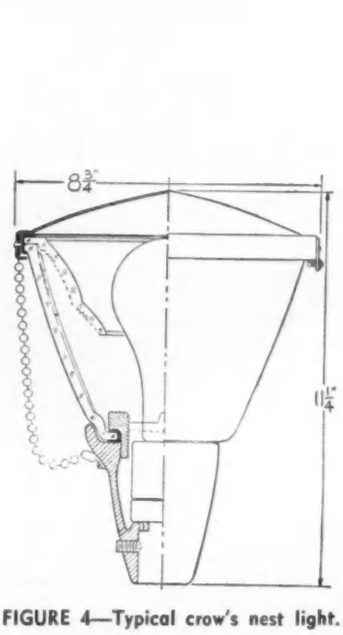
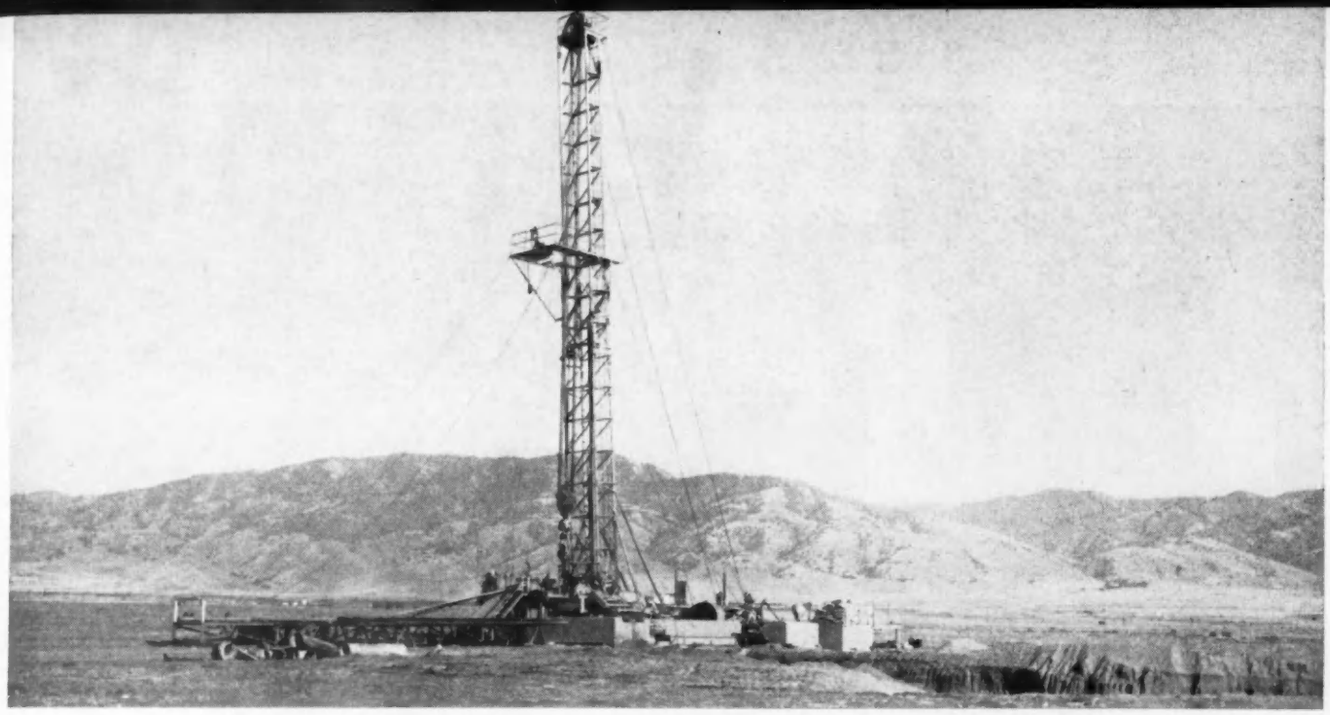


FIGURE 4—Typical crow's nest light.



"Packaged" Rigs Will Cut Moving, Rigging-Up Costs

By J. E. ARMSTRONG,
Drilling and Production Company, Bakersfield, Calif.

UNITIZATION, by definition in the drilling contracting game, is the economical combination of two or more standard pieces of equipment into a single, compact package to reduce, (1) over-all weight; (2) rigging-up and moving out time; and (3) location requirements without appreciable loss of flexibility, operating safety factor or efficiency.

This definition was the guiding principle behind the recent purchase and assembly by Drilling & Production Company of a 6000-foot capacity drilling rig, using 4½-inch, 16.6-pound pipe, in which was built a number of cost-saving unitization ideas. They started by selecting standard equipment of adequate operating safety factors that had been designed with an eye toward compactness without loss of flexibility and efficiency. The trailer-type rig incorporates a 104-foot, 200,000-pound net hook load mast, and a 450-horsepower drawworks equipped with 44 x 9½-inch water circulated brakes, complete with a 380-hp pump power take-off. The rig is powered by two compact 210-hp diesel engines driving through fluid couplings. This equipment is complemented by a 4-sheave hook-block; 44-inch rotary table; 150-ton swivel; 7¼ x 14 mud pump; and shaker. All of these are combined into unit packages with a California-type mud and circulating system, necessary because of the high percentage sand sections encountered in that state.

Packaging and unitized features of the above rig make it possible to:

- **Load out in 1¼ hours.**
- **Unload in 1½ hours.**
- **Rig up preparatory to spudding in, in 6 hours.**

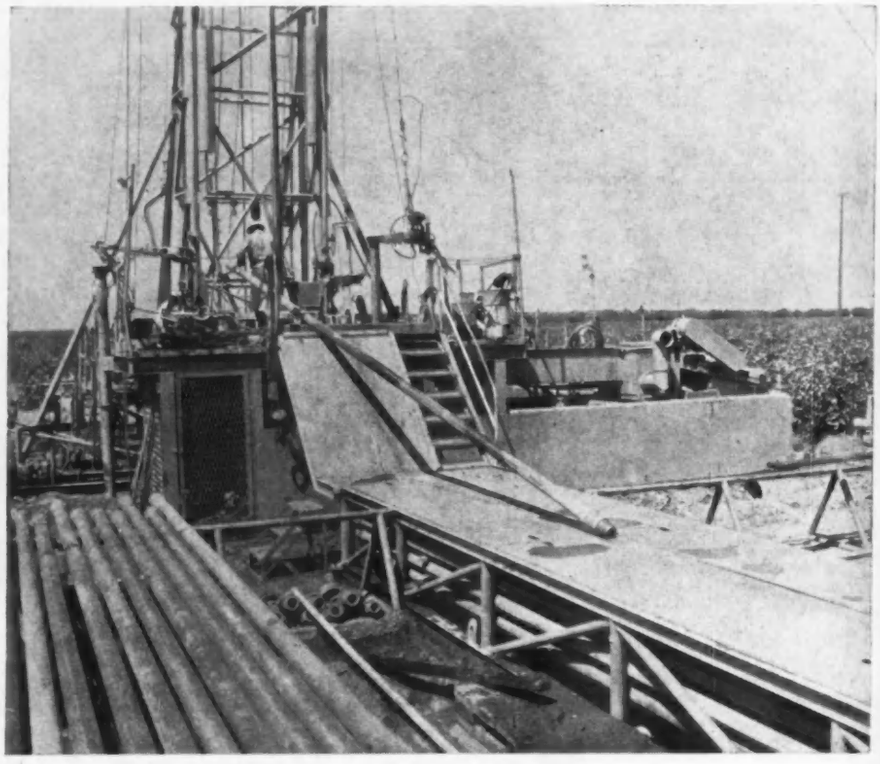
Rig is equipped with 104-foot mast which allows mouse-hole connections. Rig has capacity to drill to 6000 feet using 4½-inch drill pipe.

An examination of these packages will show how they fit the definition, and with particular attention to the resulting economies.

Package No. 1—All Purpose Trailer. Incorporated into one legal load, and mounted on a single axle, are parts of three otherwise light weight but bulky truck loads. Built into the unit, below the doghouse floor level, are a 160-barrel water tank with float valve; electric vapor-proof water pump; storage for water hose and fittings; and bulk lube oil storage. At deck level, starting at the fifth wheel end, is 2500-gallon fuel storage; 25 kilowatt diesel-driven generator; and parts room. The doghouse itself is of generous proportions, being 18 feet long, 8 feet wide and 7 feet high. Access stairway is built into the all-steel unit.

The single rear axle is dug into a shallow hole to simplify the support

This all-purpose 8x35-foot trailer combines, in a single load, a 160-barrel water tank, electric generating plant, bulk lube storage, water pump, parts room, storage for miscellaneous equipment, plus the 8x18-foot dog house. Wheels are dug into ground to allow water tank, filled only at locations, to rest directly on ground.



Center divider, horizontal channel and hinged ends, latter folding over on to the deck, feature this combination pipe basket and walk. Diamond plate decking is sectionalized for easy removal. Ramp and stairway are one piece.

of the water tank which holds water on location only.

Over-all weight is reduced by use of structural parts common to several standard pieces of equipment. The resulting savings in weight pay off, on a typical 100-mile move, at the rate of 34 cents per 100 pounds for each leg of the trip. Reducing this to money, it may be assumed that this unitized package replaces two minimum load packages of 30,000 pounds each. At 34 cents per 100 pounds, the round trip would cost $\frac{60{,}000 \text{ pounds}}{100 \text{ pounds}} \times .34 \times 2$ trips, or $408. The unitized package actually nets out at a little less than 40,000 pounds when half full of fuel, so cost would be $272, for a net saving of $136. Rigging-up and moving-out time is practically nil.

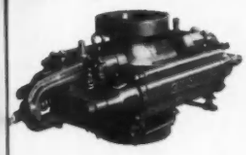
A flexible hose is run to the water source and another to the rig water system. The water pump is permanently connected and requires no piping. The electric cords and fuel lines require only a matter of minutes to connect up to the rig system. Cranes, at about $17.50 per hour, are not required to unload or set any of the equipment. Digging of a shallow trench for the rear axle requires one man about a half-hour, amounting to, say, $1.50 per well. Net savings in labor and crane time is estimated at about $30 per well.

Location requirements are at least 50 percent less for the equivalent pieces of equipment, including the load. It can be located anywhere on the location within 150 feet of the hole, such as on a wide place in the road if on a hilly location, or between rows in a vineyard, the latter being a common occurance in the southern end of the San Joaquin Valley. To assign a dollar value to the savings involved, it may be assumed that this single 35-foot by 8-foot package can save four grapevines, at $10 per vine. Throughout the design of the multi-purpose trailer, there is no sacrifice of flexibility, operating safety factor, or crew efficiency.

The potential saving per well, therefore, is in the order of $206 from this one package alone. Assuming this rig will move, say, 20 times each year, a potential saving is realized of about $4180. To be conservative, one might cut this figure in half, for a saving of around $2000 per year for the all-purpose trailer.

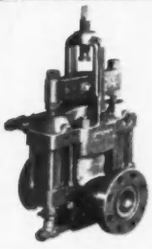
Package No. 2—Combination Walk, Pipe Basket, Tail Board, Ramp and Stairway. A center divider and horizontal channel was installed in a standard pipe basket that was decked over with removable sections of diamond plate. A hinged tail board with high-line posts was added to the far end, and a hinged pipe ramp and stairway, complete with hand rail and holdback post, was added to the other, or rig end. Approximately 1000 feet of 4½-inch drill pipe plus 150 feet of drill collar (enough to spud and set surface casing) normally is carried in this load. An A-frame truck or crane folds both ends toward the middle, sets one half of the racks on the top, and the load then is ready for tail-boarding or craning.

The remaining pipe is loaded and carried to the next location, on the day following the move, by the contractor's own company truck. This package saves rigging time with the quick-operating ramp and tailboard, but the saving involved in using the company truck on long freight hauls also may be considerable. The overall saving on a 6000-foot drill string is about 20 percent. Again on an assumed 100-mile move, there is a saving of about $75 per move. Assum-



ORIGINATORS AND LARGEST MANUFACTURERS OF:

PRESSURE-OPERATED BLOWOUT PREVENTERS



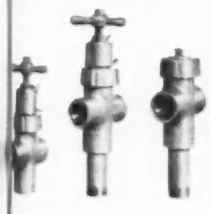
PRESSURE-OPERATED GATE VALVES

MUD-LINE VALVES

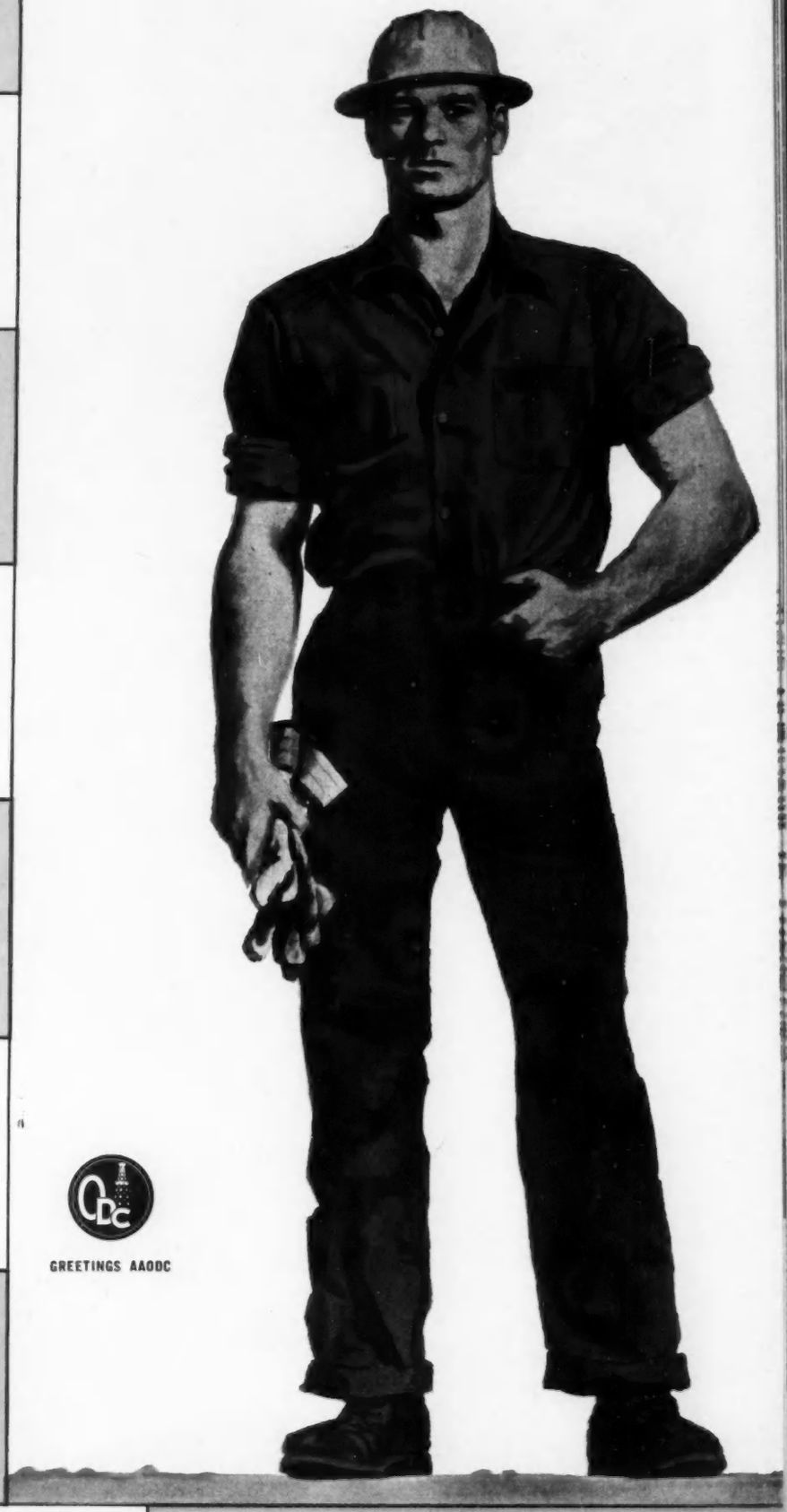
SHEAR-RELIEF VALVES

MUD-LINE PRESSURE GAUGES

COMPLETE FORGED STEEL CHRISTMAS TREES



IN A FULL RANGE OF PRESSURES AND SIZES



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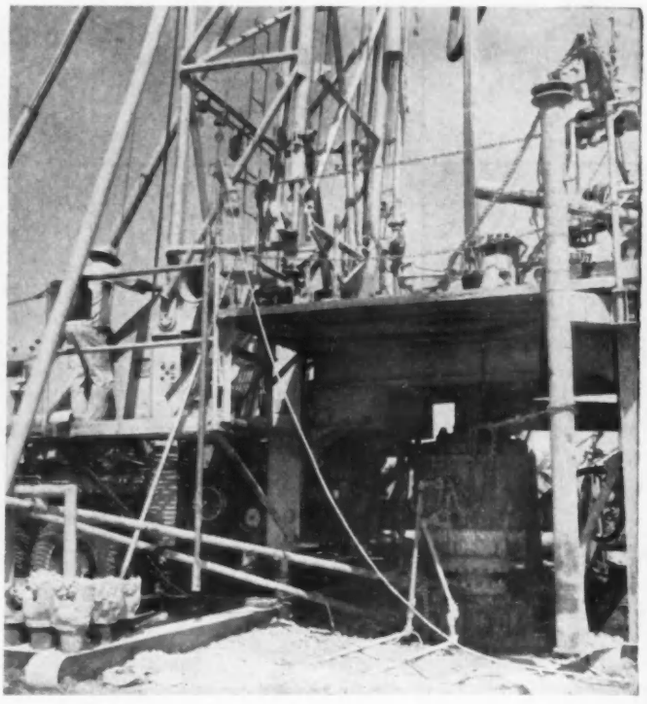
Mud rack, stand-by 50-barrel fluid storage and mud pump, while not a single unitized package, nevertheless were designed so as to require a minimum of hooking-up work. In foreground is corner of mud dock, with suction pit, latter mounted on extended skid base of pump, right. Sand ditch in center of photo.

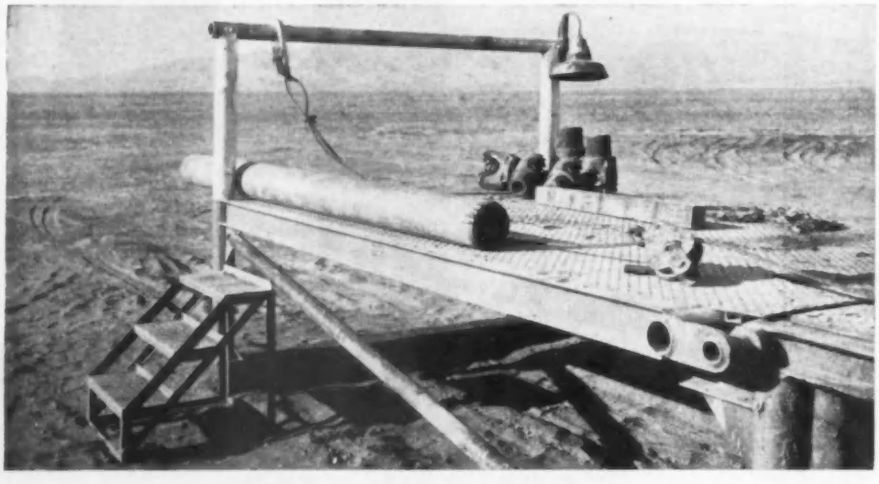


Blowout preventer installation is simplified by removal of a floor section on the driller's side. Table or table base need not be removed. Note ample room around preventers in under-floor area.

ing 20 moves per year, with, say, a 50-percent realization, the saving amounts to around $750 annually.

Package No. 3—Combination Sub-Base; 200-Barrel Mud Tank; Shale Shaker; Ditch; Sub-Storage; and Junk Bin. Combining these pieces into a single unit is a highly successful example of savings that can be effected by making one structural frame serve more than one purpose. The resulting savings in weight is, at a minimum, one 30,000-pound load per move, and with no loss of flexibility, safety factor or economy.

Resultant savings in vineyard locations recently made it possible for this rig to set up on an 88-vine location where, previously, with a competitive rig, the low was 160 vines. Assuming that about one-third of this was due to the base alone, the saving on this well in location charges at $10 per vine, was $240. This may not be realizable on every location but the saving in time in crane time per location for one set, instead of two, is a very real $10 per well, and weight savings yield $102 per 100 mile move. The saving in the initial rig cost of steel and labor of $450 made this a paying package from the start. The saving per location will vary from $10 to $350. Assuming one-half of this as a fairly average yearly estimate for the 20 locations, the saving would amount to some $1800 annually.



Hinged tail board, on combination pipe basket and walk, folds over on to walk. Highline posts, with removable horizontal member, fall outside of walk when folded over. Note that by moving steel eye along horizontal bar, equipment can be spotted at any convenient part of walk area.

Package No. 4.—Mud Rack and Stand-By 50-Barrel Fluid Storage System. Although not physically unitized with the skid-base mounted, unitized mud pump and suction pit, these units move as one load and require two crane pick-ups per move. The major saving in this package is one of rigging time since the mixing system is permanently connected to the pump and the mud rack allows convenient storage off the ground for sacked materials adjacent to the mixing system.

Since the sketch of the over-all rig was drawn, another square platform, hinged at the point where it joins the rack, and supported by two legs, was added to provide additional storage area. Hinging permits this extra section to fold over on to the adjacent floor, thereby involving no more actual area when it is being moved.

Connecting up the mud system re-

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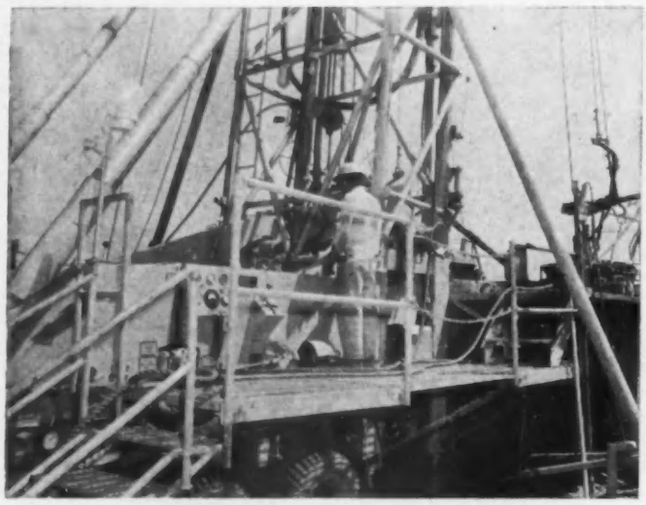
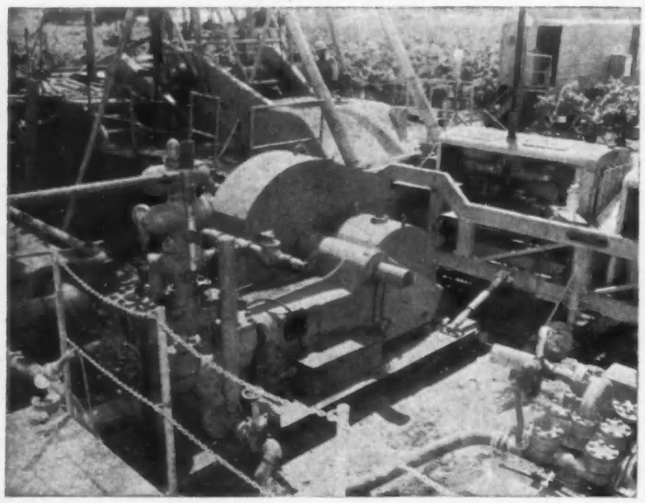


Mud pump controls and kelly dumping valve are centrally located at driller's location so derrick man need not leave floor while connections are being made.



Tail-driven 7¼x14 mud pump is unitized with suction pit and mixing equipment mounted on the same skid base. Pump controls are at driller's position.

quires but four connections: (1) A flexible bumper hose to the pumping and mixing system (4½-inch salvaged pipe serves as mixing and surface transfer mud system, as well as structural members of the tanks); (2) Flow line connections to sand trap involving two 4-bolt sleeve-type connections; (3) Bypass line to mud storage system involving two air unions; and (4) The belts from the power take-off of the rig to pump sheave. These time-saving features add up to an estimated $15 per well saving in rigging time, or a yearly $300.

Package No. 5. While not actually a package, this load consists of the sand ditch, mast base, kelly, blow-out preventer controls and other miscellaneous pieces which make up a seemingly unavoidable, non-unitized load. Actually, if it were not for the sand trap, this load could be incorporated into others but, because of the high percentage of sharp sand encountered in Recent and Tertiary formations commonly drilled in the California area, adequate sand-settling equipment is an absolute necessity.

This drilling contractor operates two rigs in the San Joaquin Valley area and has one trailer-mounted 5 by 10 mud pump that is moved between the two rigs whenever conditions require a second pump; an instance wherein one piece of equipment is doing the work of two.

Mud pump controls and kelly dumping valve are centrally located at the driller's position so the derrick man does not have to leave the floor while making up a connection.

The rig actually is capable of spooling 15,000 feet of sand line, but carries 7000 feet of the line because of weight restrictions.

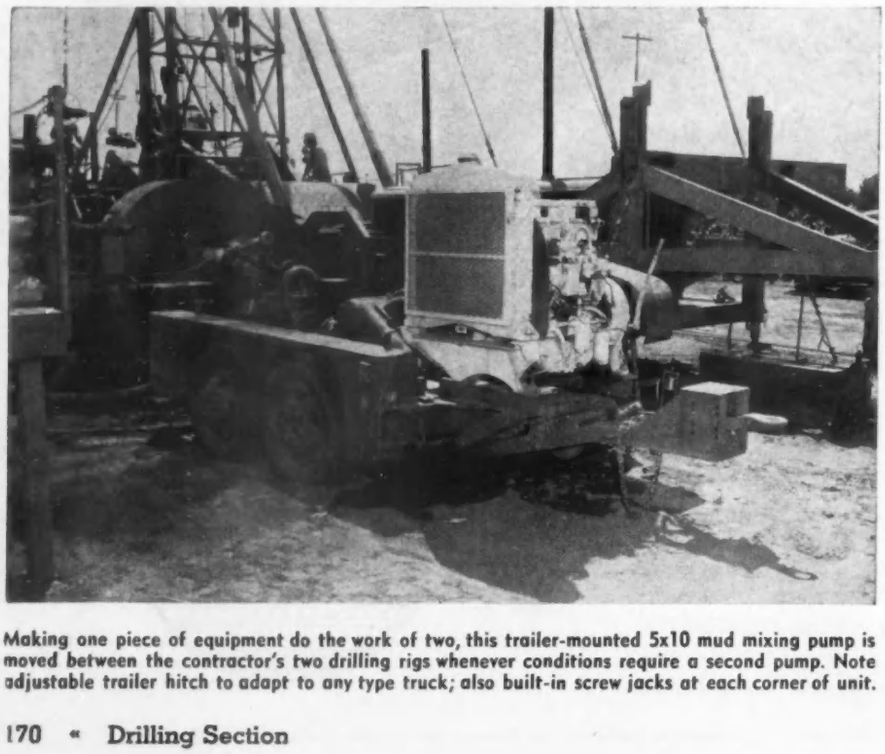
The trailer rig is mounted on a 16-wheel bogie-type axle. The 104-foot mast height allows making mouse-hole connections.

Although compact and unitized, the rig has an unusual amount of room under the floor for easy installation of adequate blow-out prevention equipment. Removal of floor section on the driller's side allows easy access to the preventer without removing table and table base.

Rigging time on a typical location amounts to about 1¼ hours to load out; 1½ hours to unload; and rigging-up ready to spud, about 6 hours.

Totaling up the economic advantages of the unitization of this highly mobile, but powerful little rig, the contractor sees a saving, per year, amounting to somewhere between a low of $4050 and a possible high of $7300. This amounts to 10 cents per foot of hole, or from 10 to 20 percent additional yearly profit.

It safely can be concluded that unitization is an economical success for any contractor. —**The End**



Making one piece of equipment do the work of two, this trailer-mounted 5x10 mud mixing pump is moved between the contractor's two drilling rigs whenever conditions require a second pump. Note adjustable trailer hitch to adapt to any type truck; also built-in screw jacks at each corner of unit.

The ill planned drilling program can lead to a million dollar mishap!

How to Prevent Blowouts

Abnormal expenditures, serious reservoir damage, extensive loss of life and equipment can result from one of the greatest hazards facing the drilling contractor—blowouts!

By T. GAINES
Texaco Exploration Company
Calgary, Alberta

BLOWOUTS ARE accidents and procedures to prevent blowouts follow the same general pattern as that of any accident prevention program. A safe drilling plan executed by trained drilling personnel using adequate equipment can prevent most blowouts. If, in spite of all precautions, a blowout occurs then employment of trained rig crews and good equipment will minimize the dangers to life and property.

If a plan is devised that will establish a mud column which can control formation pressures, and the drilling crew trained to execute this plan, then most blowouts can be prevented. If blowouts occur then the drilling crew must be trained and the rig equipped to regain control as rapidly as possible.

Operator's Responsibility. The preparation of a deliberate plan of operations for drilling is the first step in blowout prevention. This planning is the responsibility of the operator. Since the drilling of a well is a joint enterprise, the contractor should be encouraged to offer information and suggestions leading to the development of the best plan. The drilling program should be comprehensive, and copies of it should be given to the contractor in advance of the initiation of drilling. Essential parts of the drilling plan required to prepare a safe blowout prevention program include:

1. Prediction of subsurface conditions
2. Casing program
3. Mud program
4. Special operation program including drill stem testing, coring, and electrical logging.
5. Completion program

Prediction of subsurface conditions of the well should include anticipated formation tops, indicated zones of possible high pressure, prospective gas formations, and possible lost circulation intervals. The value of this prediction to the contractor is obvious in that he can use this information to select and design his drilling equipment and forewarn his crew of hole conditions that may result in blowouts.

The casing program must be designed for the specific well. Factors affecting casing include the nature of the formations to be penetrated, proposed depth of hole, and the anticipated formation pressures. These factors are usually known in planning the drilling of development and extension wells, hence designing casing programs for such wells presents no problems. In wildcat drilling, where no data is available, longer and heavier than normal surface casing strings should be run.

In deep wells or in moderately deep wells where high pressure or lost circulation formations are anticipated, the casing program may be designed to include an intermediate string of casing.

The casing program should contain procedures leading to securing a cement bond between casing and hole. The program should also contain details for pressure testing the casing and cement bond prior to continuing drilling operations to insure that the casing job will withstand anticipated formational pressures.

The necessity of a good casing program in the prevention of blowouts cannot be overemphasized because the casing strings are the foundations for the blowout preventer equipment.

Primary control of blowouts is the maintenance of a mud column of sufficient density to create a hydrostatic head greater than the formation pressures encountered. The hole must be kept full at all times to insure the maximum head. The mud program should call for measures to keep the bore full. That is, prevent lost circulation.

The density of the mud column is affected by the mud properties of weight, viscosity, and gel strength. Optimum density is that which will develop sufficient head to offset formational pressures yet not cause lost circulation. A plan of mud weights or densities should be designed to give 300 to 500 pounds per square inch hydrostatic pressure greater than the anticipated formation pressure.

The density of a mud column, hence the pressure that it exerts at the formation, may be affected indirectly by the viscosity and gel strength of the mud. High viscosity and high gel strength muds are easily gas cut, and are more likely to be "swabbed" from the hole while pulling tools. Pressure surges caused by lowering tools in viscous mud may cause lost circulation. Gas entrainment in the mud column, swabbing of the hole, and lost circulation are common causes of blowouts. The operator should plan a mud program designed to produce and maintain low viscosity, zero initial gel and low final gel strength mud in order to prevent these dangerous blowout conditions.

The drilling plan should list the special operations to be performed in the well by depths. All anticipated drill stem tests, logs, coring intervals and other special procedures should be described in the drilling plan. This information permits the contractor to be prepared to carry out these operations safely by having good hole and mud conditions at the time the operations are to be conducted.

The drilling plan should present the anticipated completion procedure of the well. This procedure must be designed from a safety standpoint, and the contractor advised so that he can prepare for its execution.

The operator's responsibility does not end with the completion of the drilling plan and its delivery to the contractor. The operator must continue to improve his plan as new drilling data is obtained and should make available at all times a qualified representative who can consult with the contractor on steps in execution of this plan.

To insure safety in drilling and protect his interests, the operator should make certain that the contractor adheres to the drilling plan. For the same reasons the operator should frequently inspect the contractors drilling equipment during the drilling of the well.

Contractor's Preparations. The contractor is solely responsible for performing the drilling plan. The contractor may obtain advice from the operator but he alone is responsible for the safe conduct of drilling operations. The contractor should prepare for the execution of a blowout prevention program by carefully training his drilling personnel and by properly designing, installing and maintaining his drilling equipment.

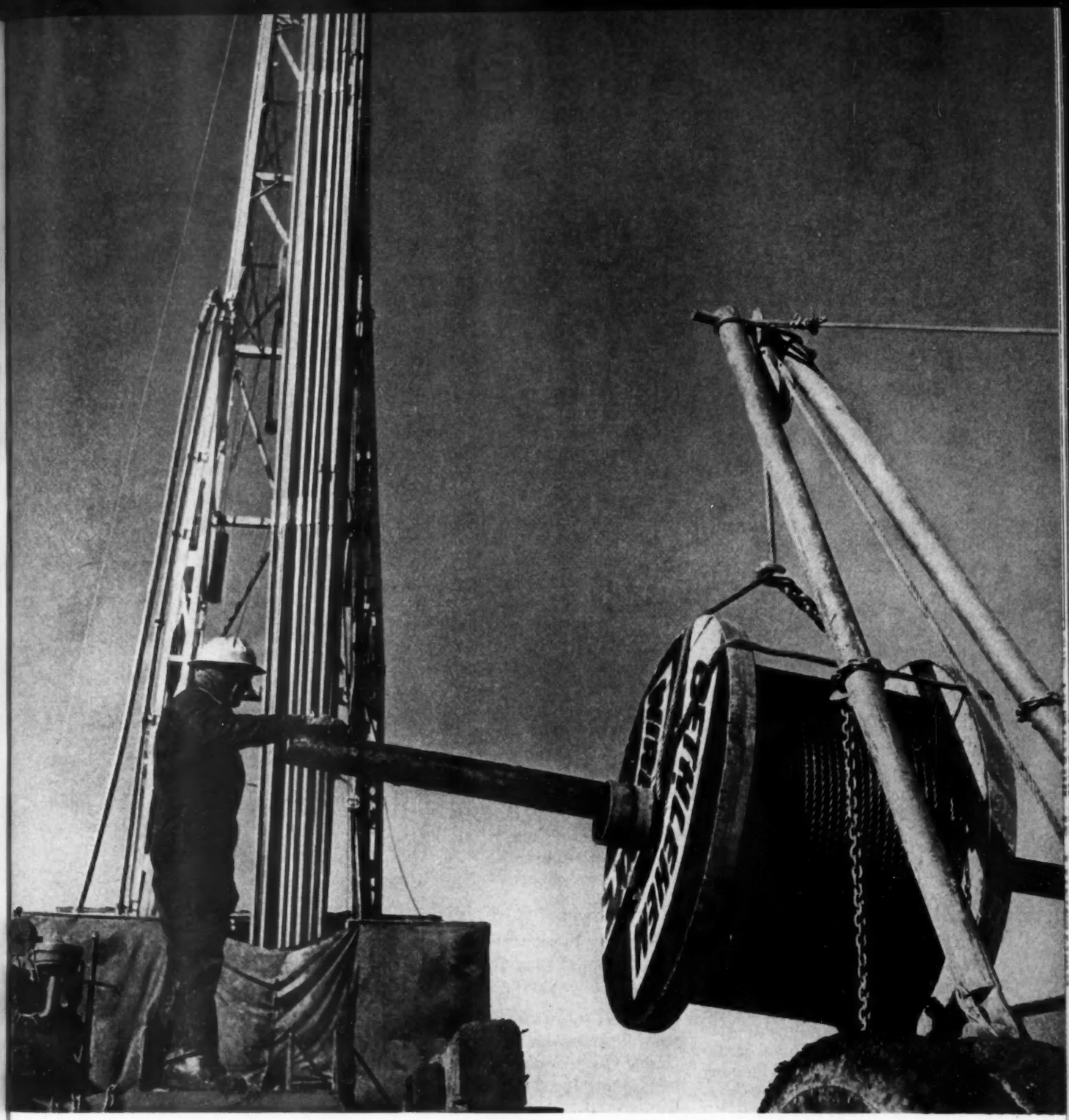
Training Drilling Crew. Safety in drilling operations and specifically in the prevention of blowouts comes from the training of drilling personnel. Blowouts are emergencies, and the drilling crews should be trained to act accordingly. The drilling crew needs indoctrination in the causes and symptoms of blowouts and repetitive drills in the operation of blowout prevention equipment. This training should be continuous and every member of the crew should be trained to perform his role and that of the other crew members.

Naturally the drilling crew should be required to maintain rig equipment and follow good housekeeping practices. Likewise the crew, particularly the derrick man, should have thorough training, preferably a formal, short course, in the treatment of drilling muds. The treatment of the mud to maintain uniform mud properties is important in blowout prevention and is the crew's responsibility.

Training of the crew to maintain the rig and the mud program and perform other day-to-day operations is not a difficult task because all these operations are performed frequently and become routine. However, blowouts rarely occur and crew interest in a training program for blowout prevention is difficult to inspire. Hence the contractor must continually emphasize training for blowout prevention and must have a good training plan.

The training program should include:

1. Discussion of conditions which cause blowouts should include the following causes:
   a. Penetration of high pressure formations.
   b. Penetration of formation in which lost circulation occurs.
   c. Low density mud.
   d. Lightening of mud column due to gas cut mud, loss of returns, swabbing hole by ripping of drill pipe or other tools, and failure to keep the hole full.
2. Instructions on recognition of the indicators of an imminent blowout to include:
   a. Gas cut mud.
   b. Loss of returns.
   c. Excessive returns of mud.
   d. Rapid acceleration of drilling rate.
   e. Water flow.
3. Instruction in the operation of blowout preventer controls include:
   a. Functioning of each preventer.
   b. Location and operation of controls.
   c. Operations of all sources of closing energy.



Wire Rope at Work—They were at 6100 ft, out in the North Sherman Field, Grayson County, Tex., when this photograph was snapped. Excellent progress had been made, and an ultimate depth of 9100 ft was expected. The rig, which is equipped with a 126-ft portable mast, belongs to Alan Drilling Co., Wichita Falls.

As the picture indicates, they didn't intend to be handicapped by a lack of wire rope. That brand-new reel contained 3500 ft of Bethlehem 1⅛-in. rotary line, 6x19 Seale. It was in good hands, you might say, for the winch line carefully easing it down to the ground was also a Bethlehem rope, ⅞-in. 6x31. These are two types of Bethlehem lines widely used in the oil fields, where they have proved their reliability and stamina for many years.

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d. Repetitive drills on blowout prevention to include: (1) closing of all blowout preventers, (2) killing of all engines, motors and fire. An occasional drill should be made when the crew is not forewarned. Each member of the crew should be trained to perform the closing operations nearest his normal duty station and trained to perform the duties of each and every other member of the crew. This should be practiced until the crew can completely close the well within 90 seconds.

Equipment to Prevent Blowouts. The contractor is responsible for installing and maintaining a rig adequate for drilling the specific well. The use of well designed, well maintained equipment instills confidence and promotes discipline in the crew. While the general condition of the rig has a direct bearing on prevention of blowouts, the mud system and blowout preventer equipment are the most important parts of the rig used in preventing blowouts. Special warning and safety devices are also necessary.

Mud System. A good drilling mud is the primary preventative of blowouts; hence the mud system should be designed to supply a good mud in large volumes to the hole.

Factors in the design of a mud system should include:

1. Reserve mud storage to meet emergencies arising from lost circulation, loss of mud and gas entrainment. The necessary volume of reserve storage will, of course, vary with the depth and character of drilling.
2. The housed storage of mud materials convenient to mud mixing facilities. The amount of mud materials to be maintained is dictated by anticipated drilling conditions but should be more than ample for any emergency.
3. Mud mixing equipment designed for rapid mixing of large volumes of mud. For all wildcat drilling a second slush pump is needed so that the mud can be mixed and the hole circulated simultaneously. The second pump can be used as a stand by pump, an essential in wildcat and deep well drilling.
4. Special devices such as a choking arrangement on the bleed off line, drill pipe protectors, etc.

Blowout Preventer Equipment. The blowout preventer equipment is a secondary system of blowout control. Blowout preventers do not prevent blowouts; rather their use is a stop gap measure to be employed while the mud column or primary blowout control is rebuilt. As a substitute for the mud column the blowout preventer equipment should have similar characteristics to those of the mud column; that is, the blowout preventer equipment should:

1. Be automatically adjustable to close on any equipment which may be run in the hole.
2. Must be immediately available and completely effective for any anticipated emergency.
3. Must be closed by controls which are simple and easily operable so that the least motion, mental thought, and physical effort is required of the crew in closing the preventers.

The blowout preventer system to be wholly effective must be designed to perform the following functions:

1. Close on open-hole.
2. Close on any type of drill stem or any tool which might run in the hole.
3. Close the opening within the drill stem or any other hollow tool that might be run in the hole.
4. Permit rebuilding of the mud column under pressure.
5. Permit movement of the drill stem under pressure.
6. Permit the installation of additional blowout preventer equipment for stripping or running the drill stem or any other tools.

Blowout Preventer Control System. The design of the controls for closing the blowout preventer equipment is as important as the design of the blowout preventer equipment.

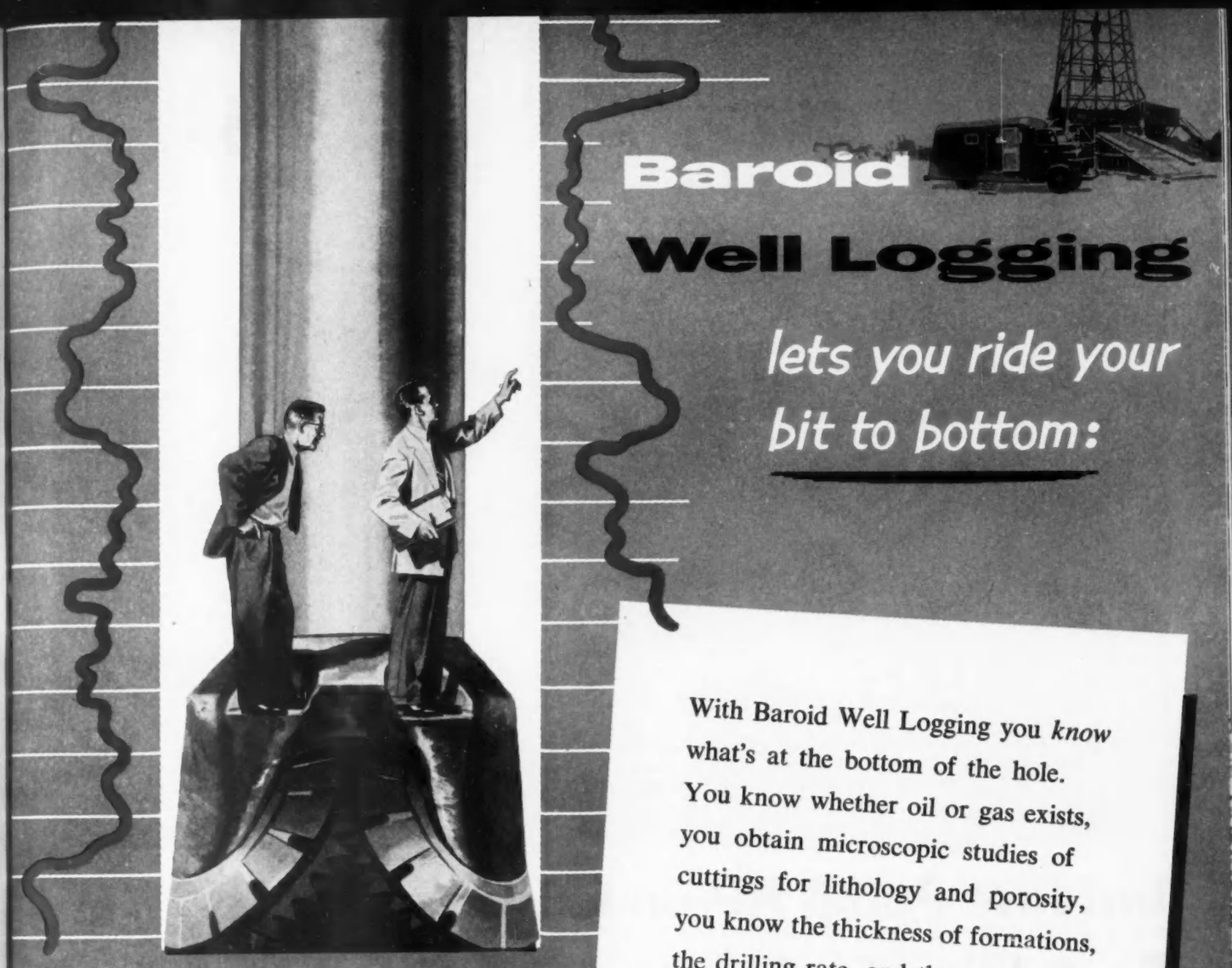
Following are fundamental requirements in the design of blowout preventer controls.

1. Controls must close the preventers swiftly. As noted earlier, a well should be closed in within 90 seconds. Manual closing of blowout preventers is too slow for emergency conditions in most areas of drilling and hydraulic closing must be employed.
2. The closing controls must be simple in operation and clearly marked with operation instructions.
3. The controls must be located so that they can be quickly and safely reached. The blowout preventer system should have a dual set of controls—one on the rig floor and the other at a safe distance from the rig (not less than 75 feet away).
4. The controls must have more than one source of closing energy, particularly where the principal source may be dependent on the operation of a motor or engine. The closing system should include a motor or engine driven hydraulic pump with an accumulator tank which contains at all times sufficient liquid under pressure to close all controls at least twice. Secondary closing equipment should include a manually operated hydraulic pump and cylinder of an inert gas under high pressure. All of these energy sources must be located in a place safe from destruction in the event of a blowout and/or fire. All energy sources must be connected to the controls with as little valving as is practical.

Warning and Safety Devices. Certain warning and safety devices should be installed on all rigs. A warning device considered essential is a float device to warn the crew of a sudden change in the level of the mud in the surface pits. The safety devices would all be designed to extinguish all sources of open flame in the event of a blowout. A master switch which will kill instantly all engines should be installed at the blowout preventer panel. A similar switch may also be installed at the remote blowout preventer control station. Boilers should be equipped so that steam can be flowed instantly into the firebox. All other open flame equipment should be equipped for rapid extinguishment.

Conclusions. Most blowouts can be prevented by the execution of a safe drilling plan. It is the operator's responsibility to prepare a safe drilling plan.

The contractor is responsible for the execution of a drilling plan. To carry out a safe drilling plan he must properly train his drilling crew and equip his drilling rig. The crew should be trained to understand the causes, recognize symptoms, and act with dispatch in preventing blowouts. The crew must be supplied with adequate, quick acting blowout prevention equipment. These measures will prevent most blowouts. —**The End**



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At some future date, if reserve engine power is needed, a fourth engine unit can be added to the sectional drive group of this West Coast contractor's rig, which is now equipped with three 450-horsepower engines and two mud pumps, one in the 1000-hp class. Engines are torque converter equipped.

Increase Pump HP on Existing Rigs By Adding Engines to Drive Group

In the race for increasing penetration rates, input horsepower to pumps has roughly doubled during the past ten years. The trend in rig arrangement is to consolidate all engines in the one drive group.

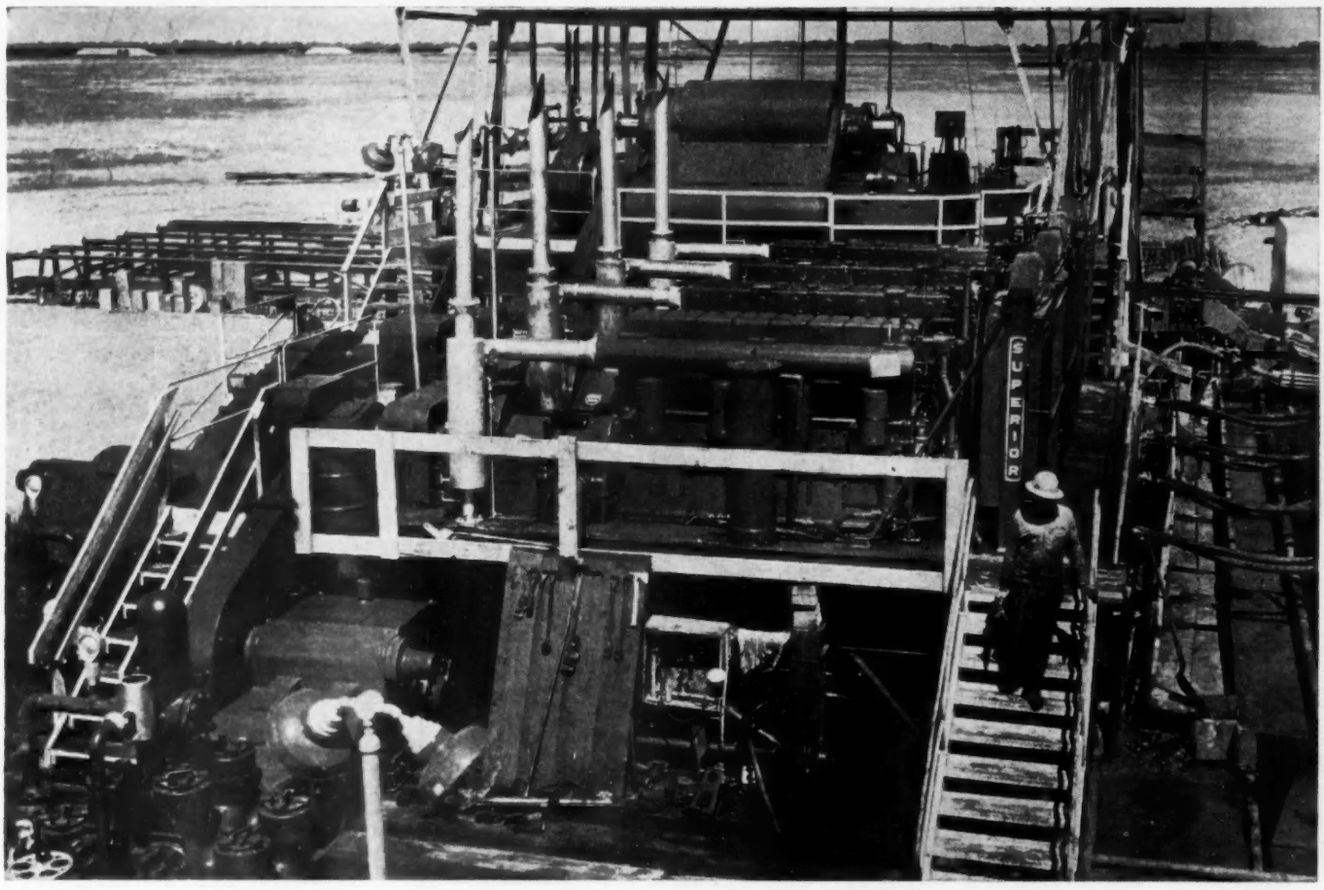
By R. W. CRAIG, Sales Engineer,
The National Supply Company,
Torrance, California

In order to increase drilling speed and improve efficiency of drilling operations in general, drilling contractors are installing more pump power on their drilling rigs. Higher mud pressure and circulation of greater volumes also have been encouraged by the advent of the jet bit and in the interest of faster penetration. It is considered that with more rapid circulation the drilling mud can also be processed better.

Drilling rigs run better with more power and actually the crews do a better job when reserve engine power and adequate pump capacity are available. Drilling conditions are best when the equipment is not stressed or pushed to its limit.

Many contractors rigs, in use today, were purchased 10 to 15 years ago, roughly between 1941 and 1946, when the more modern power rigs came into being. At that time, such rigs were considered to be well powered when equipped with three engines of the 300-horsepower class. A drive group with three of these engines represented a maximum total of about 1000 hp but a continuous drilling and pump powering rating of only 750 hp. As an average, on many deep and difficult drilling jobs, only some 500 hp, or less, actually was powering the pumps.

A few drilling engines in the 400-hp class were placed in drilling service prior to 1950. Drive groups equipped with four engines then were popular on perhaps 25 percent of the heavy duty rigs. A few of the contractors' rigs were equipped with outside pumps powered with up to 500 hp but, as an average, and for continuous drill-



New rig belonging to a California contractor has four engines totaling 1600 hp, which can be allocated to a 700 and a 1000-hp pump. Rig is currently on a deep test near Sacramento.

ing with more than 500 hp going to the pumps, this was the exception rather than the rule during the early 1940's. The heavy duty power pumps at that time carried an input rating in the vicinity of 500 hp.

Trend Toward Larger Pumps. At the present time, pumps of from 700 to 800 hp input rating are being placed in operation by contractors on their deeper drilling jobs. Pumps of 1000 hp input rating capacity are being manufactured and these are being installed on contractors' rigs, but in somewhat fewer numbers than the 750-hp sizes. The input power to the pumps on the typical contractors' rigs during the last ten years has roughly doubled. Although exact figures are not available, it would appear that they have more than cut in half the drilling time during that period.

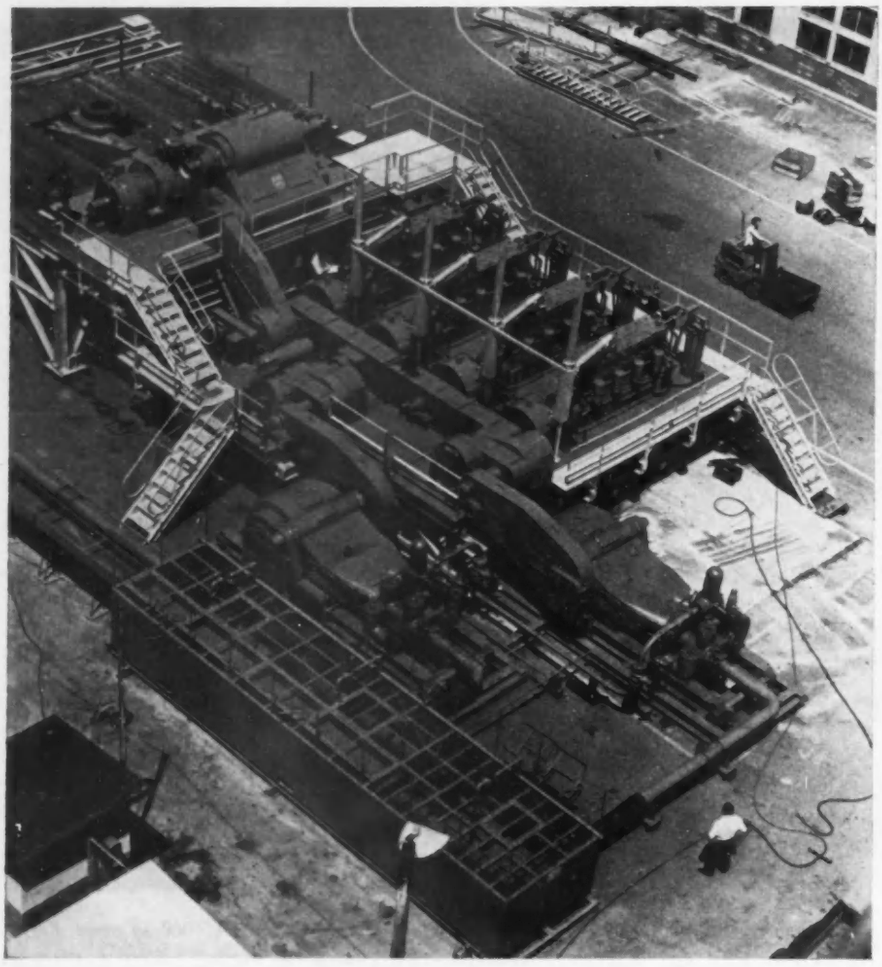
The transition was felt in the design of the pumps; there being an increased number of the wearing parts and more frequent failure of the working parts. Main pump elements have been strengthened along the line and many of the older pumps are getting by in spite of the stepped-up loading to which they are being subjected.

Periodic Inspection of Older Pumps. Some contractors have followed a system of periodic inspection and replacement of worn parts with their pumps, and this has been paying off in extended pump life. In some cases, it has been found that by increasing the speed, their pumps will get by with increased loading. It is generally conceded, however, that utilizing the older pumps for present high-capacity demands is more or less temporary and that within a few years most pumps will be replaced with the 700 to 1000-hp varieties.

During this transition period, increased loading of the engines also has been noted. For the most part, only two of the 300-horsepower class engines were available on the rigs of 10 years ago for powering the pump. If the pump demanded more than 500 hp for long periods of time, this condition showed up as overloads on the engines. Frequently it developed that only two engines were not enough for the pump. This under-powered condition was remedied in some cases by adding another engine or two to the pump drive.

All Engines in One Drive Group Desirable. It generally was found that on a heavy-duty drilling rig, with one or more independent pump drives, more often than not, the engines were overloaded and the pumps were under-powered. With such rigs, it was not always possible to distribute the power of the several engines to the best advantage. The trend in rig arrangement has been away from any independent pump units and, instead, to the practice of consolidating all engines in the one drive group. This preference for assembling all engines together, and which may number from 1 to 5, now results in adequate power being available at all times to the pumps. Another important advantage which contractors have found is that by locating all of their power in one place, the drilling engines, under most drilling conditions, can be operated at somewhat less than their rated capacities. Maintenance, therefore, can be kept to a minimum.

Convert 4-Engine to 5-Engine Groups. Basically, there have been two methods of providing more power



Maximum in pump power is demonstrated by many large overseas companies. Drilling contractors, operating some of these large rigs, have been responsible for recommending the higher pump capacity, along with plenty of engine power. Rig shown above (owned by a South American government company), has four 450-hp engines, two 1000-hp pumps, coupled with fluid drives.

About the Author

R. W. (BOB) CRAIG graduated from California Institute of Technology in 1921 and, after earning his B.S. in mechanical engineering, joined The National Supply Company in the Engineering department. He has specialized for a number of years in the engineering of large rotary drilling rigs, many of these being located in overseas drilling operations. He has set up rigs in numerous foreign countries. During the last year he has engineered the "doubling of pump power" of large rotary rigs in the Middle East, Assam and Papua.

for the pumps. One of these is to purchase new engines and drive groups with adequate power. The other is to add more engines to existing drive groups. One enterprising California contractor has followed this latter route, originating the practice, several years ago, of redesigning his 4-engine drive groups into 5-engine models. This system worked out so well for this contractor that he purchased several new 5-engine rigs. He now operates some 8 or 9 rigs, all of the same general pattern; that is, with 5-engine groups, and with two pumps driven from the rig. Some 30 of these "adding engines to the drive group" jobs can be accounted for during the last several years in California and in overseas drilling operations, the primary purpose of which was to increase pump power.

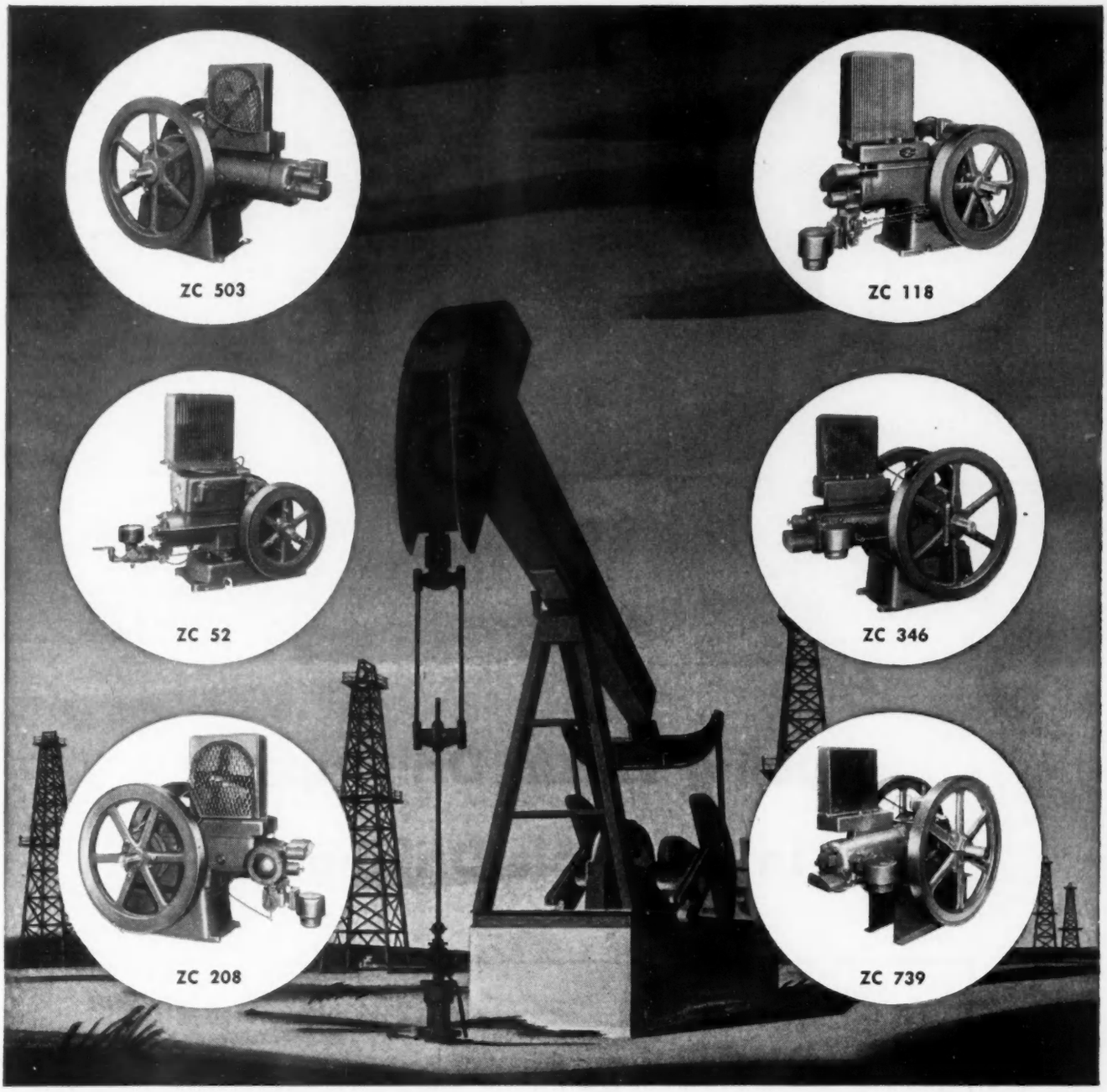
During the last two years about as many heavy-duty rigs have been sold for overseas operation as have been sold to contractors in the U. S. For the most part, contractors did not purchase these rigs for operation in foreign fields, but have exerted some very welcome influence on the design. In these operations, a higher standby factor is taken into account and the placing of four of the larger engines in the drive group has been the general rule.

The general practice with most contractors is to arrange three of the now larger engines in the drive group in order to adequately power the now more powerful pumps.

Hydraulic Drives Extend Life. Another feature which should be mentioned when discussing the doubling of pump power on drilling rigs during the last 10 years is the fact that perhaps 90 percent of the new engines powering the 700 and 1000 hp pumps are equipped with hydraulic couplings or torque converters. It is felt by most contractors that these hydraulic drives are quite useful and that they improve pump and drilling efficiency. It further is contended, by both manufacturer and the contractor, that wear and tear on the machinery, in general, is diminished by use of the hydraulic drives. Ten years ago, very few hydraulic drives were in use on contractors' rigs.

In the over-all picture, where contractors are placing rigs in operation with 700, 850 or 1000 hp pumps, it is noted that perhaps 70 percent of the transactions, new and more powerful engines and drive groups are being purchased along with the new pumps. These are virtually completely new rigs. The investments being made by contractors in high pump capacity drilling equipment and rigs is large, but practically all contractors now engaged in deep drilling now have at least one or two and even more rigs which feature the 700 or 1000 hp pumps and which have adequate engine power to operate these pumps.

—The End



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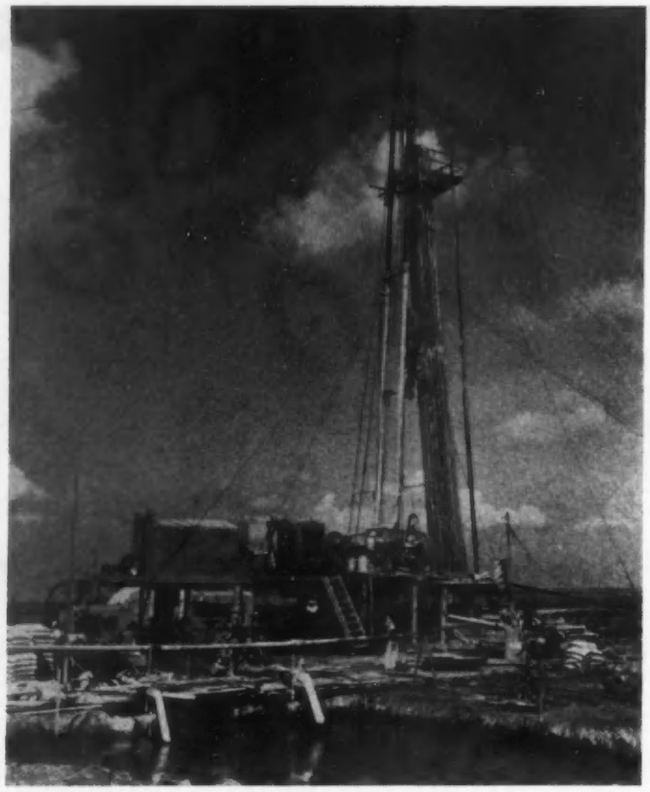


Tubing Versus Drill Pipe In Slim Hole Drilling

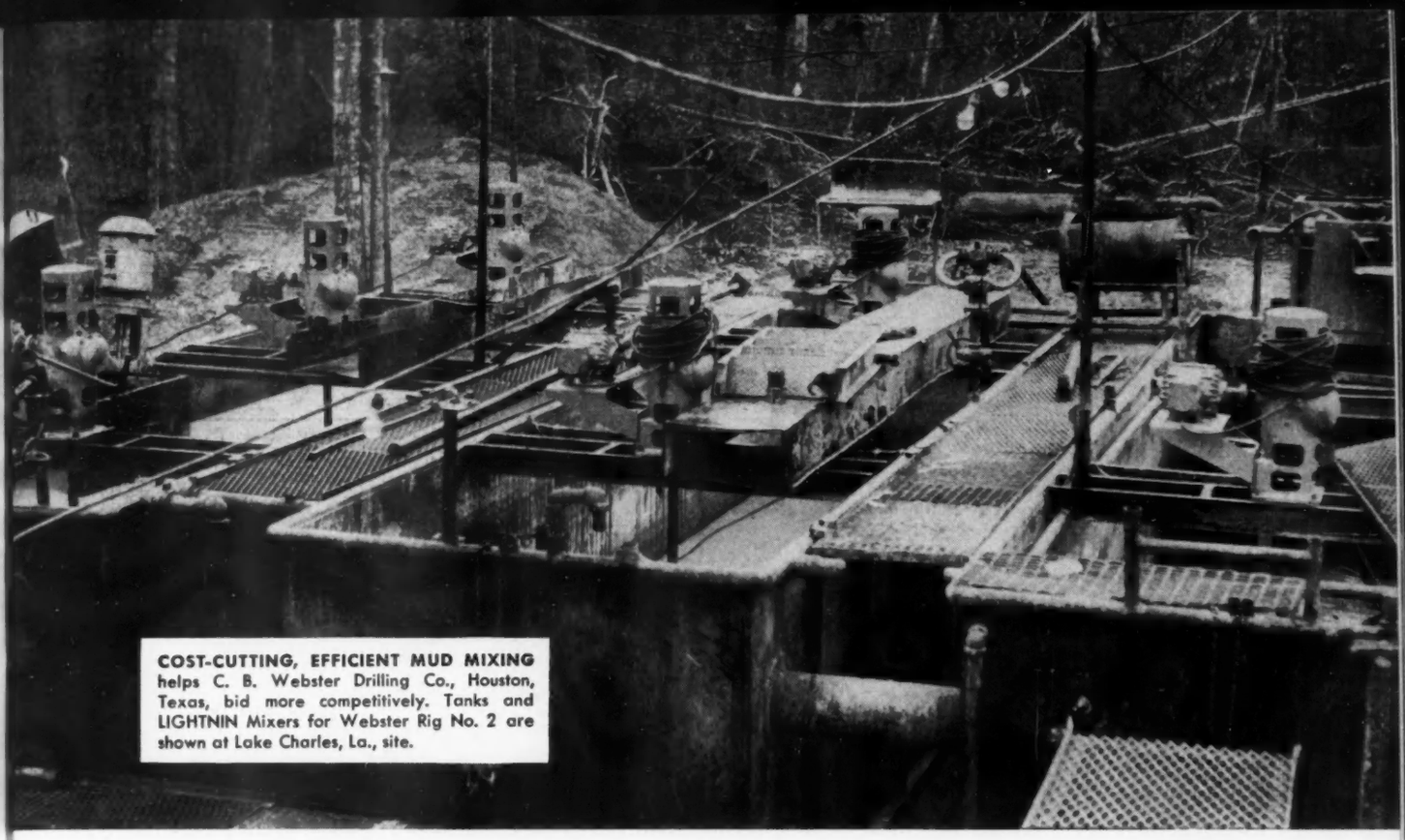
Below 14,500 ..... 2⅜ tubing or 2⅜ drill?
Below 15,500 ..... 2⅜ tubing or 3½ drill?
At any depth ..... 2⅜ tubing or 2⅜ drill?

Which is Strongest?

By D. M. BEST
Gulf Tool Company, Inc.
Houston

AT THE PRESENT time there is a trend among the oil companies toward drilling smaller diameter holes. These are holes in which the casing to be run is smaller than 5½-inch outside diameter. The popular hole size in slim hole work is either 5⅜ or 4¾-inch. The term slim hole drilling should include any work done inside these diameters such as completion, workover, fishing, deepening, and even the embarrassing operation of drilling out accidently cemented up casing. It certainly cannot be limited to new hole only. Also to be added to this general category is any operation for which lighter than ordinary pipe is used.

The economics of the slim hole trend can be readily appreciated. First it is possible to use a lighter and smaller rig resulting in appreciable savings in either capital or rental outlay. However this is only the beginning in the over-all economic picture. All of the handling equipment required in either smaller or, as in the case of transportation equipment, more can be moved in the same period of time per piece of mobile equipment. The casing to be used in the drilled hole is smaller as well as all of the allied tools to be set therein; the drill string, including pipe, drill collars, substitutes, bits, safety joints



COST-CUTTING, EFFICIENT MUD MIXING helps C. B. Webster Drilling Co., Houston, Texas, bid more competitively. Tanks and LIGHTNIN Mixers for Webster Rig No. 2 are shown at Lake Charles, La., site.

How C. B. Webster keeps drilling costs low

This contractor drills deep holes with less mud . . . and passes savings on to customers

TAKE a tip from C. B. Webster, drilling contractor who found this new way to cut drilling costs.

He saves money on mud, by keeping his mud in top condition—always fluid, always ready—with LIGHTNIN Mud Mixers. And he avoids the cost of using a mud pump for tank circulation.

Here's the story, as Mr. Webster tells it:

"Recently we purchased six of your LIGHTNIN Mud Mixers and one LIGHTNIN Flash Mixer for installation on standard land tanks on our Rig No. 2, currently operating in the Lake Charles, La., area. And we are certainly pleased with their performance.

"As you may know, the mud bill for deep hole drilling, such as we are doing in Louisiana, is a pretty expensive item. Having LIGHTNIN Mixers on our mud tanks has helped cut down the mud bill. And cutting costs is the number one aim of every drilling contractor.

"Then, too, your mixers kept our mud ready at all times for any emergency, and saved us installing another mud pump on tank circulation.

"Adding LIGHTNIN equipment has helped us make savings that we can, in turn, pass on to the people for whom we are working.

"The Flash Mixer has given us top performance, too, when we have needed it. On mixing gels there has been no clogging, regardless of how fast we fed the material.

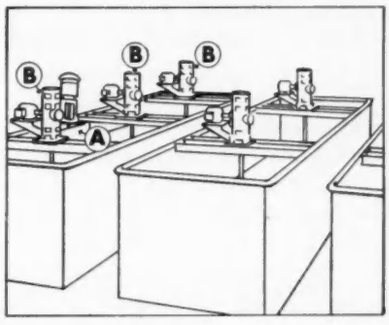
"We think the addition of LIGHTNIN Mixers to our rig equipment list will improve our position on future drilling bids.

"If any of your engineers would like to see our mud pit setup, we'll be more than happy to give permission for them to visit our rig on location."

See for yourself

Drilling men are using LIGHTNIN mud control on many rigs. You take no risk with LIGHTNIN Mud Mixers. Every LIGHTNIN is guaranteed to mix mud the way you want it mixed—faster than anything you've ever seen.

Get the facts firsthand. Ask your LIGHTNIN sales engineer to arrange a field trip to a rig in your area so you can see LIGHTNINs at work. You'll find his name listed in Composite Catalog —or just write, wire, or phone us direct.



UNIFORM MUD. Simplified drawing shows how Webster gets instant control of mud weight and viscosity. Weight and gel additions are dumped into the LIGHTNIN Flash Mixer well (A) by the sackful. The turbine-type LIGHTNIN Mud Mixers (B) equalize mud in a few seconds. Mixers keep mud flowing. It can't settle out. All the mud is ready for instant use. And Webster eliminates cost of replacing pump parts, valves, fittings worn out in mud agitation service. LIGHTNINs require virtually no maintenance.

SEND FOR this free 6-minute picture story. It shows how you get instant mud control and cut costs, too, with LIGHTNIN Mud Mixers.

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"The hanging load . . ."

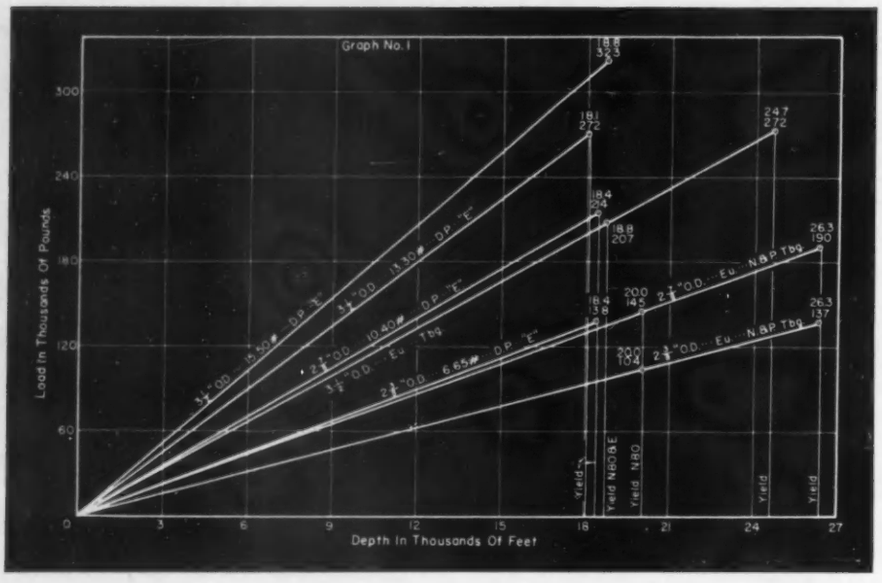

FIGURE 1

"The maximum depths . . ."

TABLE 1

TYPE PIPE	Maximum Depth Limit
2⅜ inch EU N 80 Tubing	20,068 Feet
2⅜ inch EU P105 Tubing	26,330
2⅜ Inch Grade E Drill Pipe	18,430
2⅞ Inch EU N80 Tubing	20,049
2⅞ Inch EU P105 Tubing	26,315
2⅞ Inch Grade E Drill Pipe	18,430
3½ Inch EU N80 Tubing	18,836
3½ Inch EU P105 Tubing	24,723
3½ Inch Grade E 13.30 lb. Drill Pipe	18,105
3½ Inch Grade E 15.50 lb. Drill Pipe	18,767

and other tools naturally are cheaper in both original or rental cost and rework cost. And last, but not to be overlooked, there is often a saving in over-all time which places the well on production sooner.

One of the items of greatest concern in slim hole drilling is the type of drill pipe to be used. Of course, standard oil well tubing is the logical answer as will be shown. This tubing equipped with tubing tool joints is entirely adequate for such drilling and at greater depths will be shown to be superior to comparable size drill pipe. Many years ago quite a few of the operators successfully used the old H-40 grade tubing. When J-55 grade tubing was introduced these operations became more feasible and common practice. With the N-80 grade of tubing, over-all strengths became so close to comparable drill pipe that almost all operators will readily use such tubing for completion, workover, deepening, and drilling operations. Now that P-105 grade is becoming available, we have oil well tubing of greater strength than the comparable size drill pipe.

In order to save the finer, standard eight round form pipe threads on the pipe ends it is now common practice to use tubing tool joints. These tool joints also speed up the round trip time in addition to taking all the make and break wear. Some operators purchase the tubing without couplings or remove them and apply the tool joints directly to the tubing while others use a type that can be added to the tubing string for drilling operations and then can be removed so that the same drill string can be set for production. This latter practice completely eliminates the need for one string of pipe.

Tubing tool joints with streamlined outside diameter and with full bore are available. The strength of such joints are ample and they offer no clearance disadvantage either inside or outside. Hydraulics involved are greatly in favor of these type joints.

A general survey has been made on one hundred workover, fishing, deepening, completion, and slim hole drilling jobs on which J-55 or N-80, 2 ⅜-inch EU or 2½-inch EU tubing equipped with tubing tool joints was used at depths from 5000 feet to 16,000 feet.

Results conclusively indicated that no pipe difficulty was experienced; light duty rigs were generally used; hydraulic factors were on an efficient level; penetration rates were normal; transportation facilities required were at a bare minimum; and squeeze pressures in the order of 8000 pounds per square inch were employed. One operator drilled a 5900 foot slim hole using 2⅞-inch EU N-80 tubing equipped with 3- 11- 16-inch OD tool joints and 3¾-inch OD drill collars in 22 days. Another deepened from 10,000 feet to 10,774 feet using 2⅜-inch EU N-80 tubing with 3 1/16-inch OD tool joints in 11 days. Bit size was 5⅝-inch, casing to 10,000 feet was 6⅝-inch, and a 4-inch liner was set to 10,774 feet. Another operator drilled 5000 feet of cemented 5½-inch casing in 21 days using 2⅜-inch EU N-80 tubing equipped with tool joints. The survey also showed a successful casing cutting and side tracking job.

A very often disregarded factor is present (see *The Oil Weekly,* April 14, 1947) in all pipe suspended in an oil well. This is the factor of combination loading. One or more joints of pipe in a horizontal, supported position can be subjected to a very definite torque loading. However, when subjected to tension such as hanging in the well under its own weight or greater (in the case of applied pull on a fish), there is an induced shear in the pipe. This induced shear materially reduces the torque below that which it will stand were there no tension. It will be noted that this reduction is close to 50 percent at great depths.

A complete set of calculations has been made for the various comparable tubing and drill pipe sizes. Results are plotted for easy comparison and are shown in Figures 1, 2, and 3. Tabulations from the calculations and graphs are shown in Tables 1, 2, and 3. For the purpose of comparison and in some cases simplification, the following conditions were assumed in all calculations:

a. Perfect Pipe
b. Straight Hole
c. 100 percent efficient joints

"Maximum allowable pull . . ."

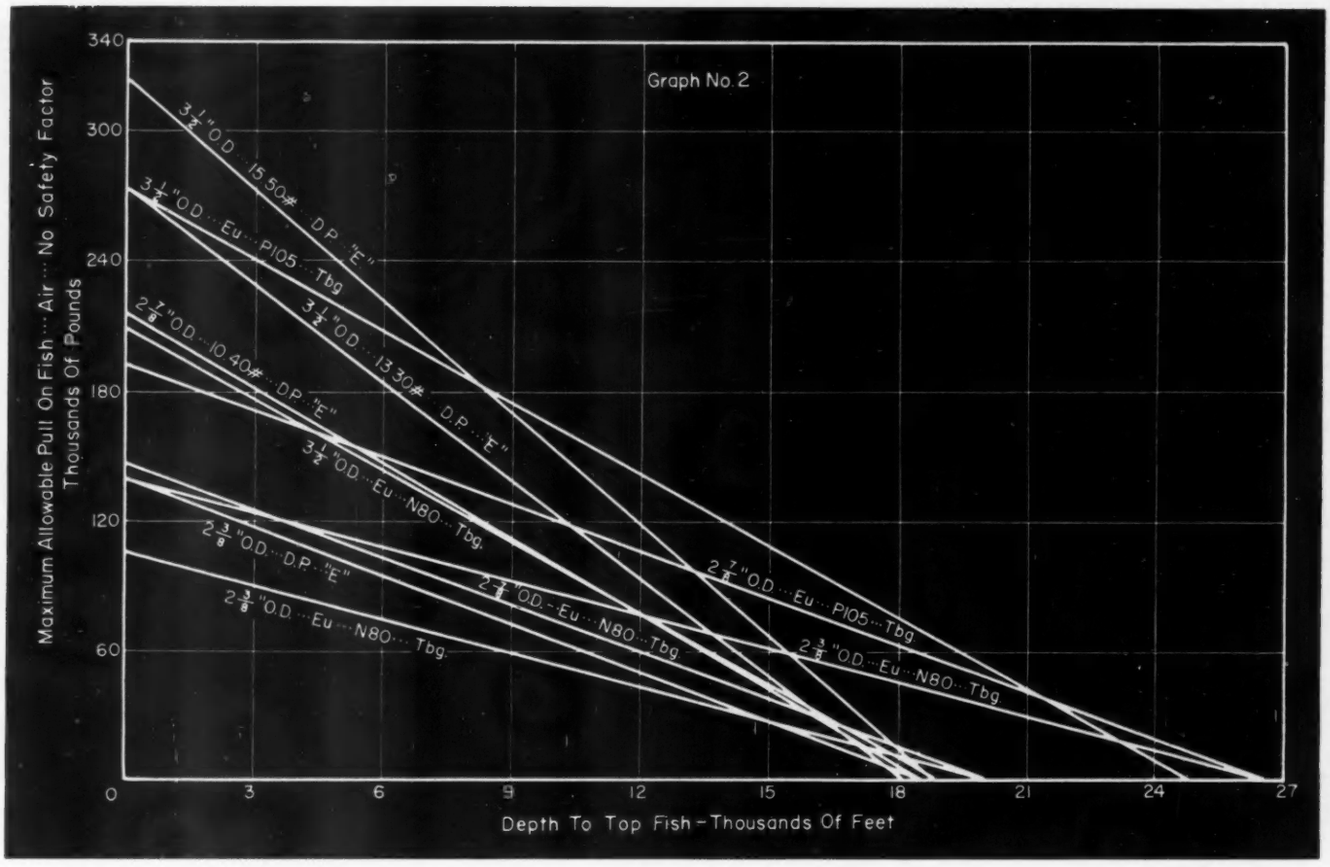

FIGURE 2

d. Tool joints on every 30-foot length of tubing and drill pipe
e. No buoyance effect
f. No drill collars
g. No safety factor
h. Yield tensile stress:
Grade E Drill Pipe.. 75,000 psi
N 80 tubing ..... 80,000 psi
P-105 tubing .....105,000 psi
i. Yield shear stress: 60 percent of yield tensile stress in all cases.

All calculations were based on the folowing equations:

a. $S_{smax} = 0.6 \times S_{tmax}$
where S_{smax} = Maximum allowable shear stress in psi.
S_{tmax} = Maximum allowable tensile stress in psi.

b. $S_t = L/A$
where S_t = Unit tensile stress in psi.
L = Load on top joint of pipe in pounds.
A = Cross sectional area of pipe in square inches.

c. $S_{smax}^2 = S_{ss}^2 + \frac{S_t^2}{4}$

where S_{ss} = Unit shear stress due to rotary torque that can be added to the unit shear stress induced in the pipe by the tensile load, in psi.

d. $T = S_{ss} \times Z_p$
where Z_p = Polar section modulus = $\left[0.196 \left(\frac{OD^4 - LD^4}{OD}\right)\right]$ in.^{3}

T = Torque required to produce the unit shear stress of S_{ss} in inch-pounds.

Figure 1 shows the hanging load plotted against the depth for the various pipe sizes and types under consideration. Table 1 is a tabulation of the maximum depths to which these may be run. The pipe will fail in tension at any greater depth.

Figure 2 shows the maximum allowable pull that may be applied to a fish using the various types and sizes of pipe for all depths. Table 2 is a tabulation from Figure 2 for comparison purposes at 0 depth and again at 10,000 feet.

Figure 3 was plotted from the calculations and shows the maximum allowable torque that may be applied

"Comparison . . . 0 depth and again at 10,000"

TABLE 2

TYPE PIPE	Maximum Pull @ 0 Feet	Maximum Pull @ 10,000 Feet	Maximum Pull @ 15,000 Feet
2⅜ Inch Grade E Drill Pipe	138,225 lb	63,225 lb	25,000 lb
2⅜ Inch EU N 80 Tubing	104,340	52,340	26,000
2⅜ Inch EU P 105 Tubing	136,920	84,920	60,000
2⅞ Inch Grade E Drill Pipe	214,350	98,050	40,000
2⅞ Inch EU N 80 Tubing	144,960	72,660	36,500
2⅞ Inch EU P 105 Tubing	190,260	117,960	82,000
3½ Inch Grade E 13.30 lb Drill Pipe	271,575	121,575	46,000
3½ Inch Grade E 15.50 lb Drill Pipe	322,800	150,800	65,000
3½ Inch EU N 80 Tubing	207,200	97,200	43,000
3½ Inch EU P 105 Tubing	271,950	161,950	107,000

"Maximum allowable torque . . ."

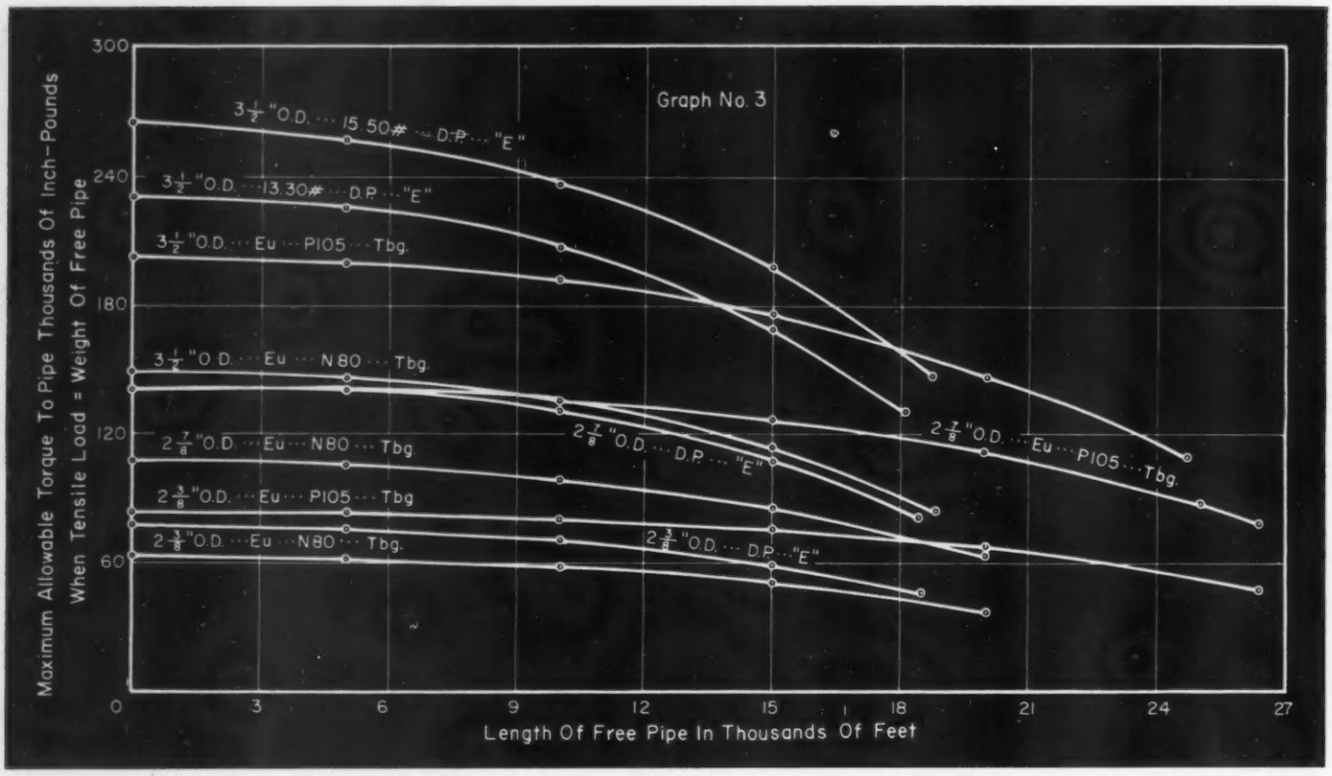

FIGURE 3

"Comparative figures . . ."

TABLE 3

PIPE	Yield Torque No Tension Inch-Pounds	Comparison	Yield Torque 10,000 Feet Hanging Load Inch-Pounds	Comparison	Yield Torque 15,000 Feet Hanging Load Inch-Pounds	Comparison	Yield Torque 18,000 Feet Hanging Load Inch-Pounds	Comparison
2⅜ Inch EU N 80	63,400	81% D.P.	55,700	80% D.P.	49,000	86% D.P.	42,000	93% D.P
2⅜ Inch EU P 105	83,200	107% D.P.	78,900	114% D.P.	74,000	129% D.P.	70,000	155% D.P.
2⅜ Inch Drill Pipe "E"	77,900	.....	69,500	.....	57,000	.....	45,000	.....
2⅞ Inch EU N 80	107,000	75% D.P.	97,600	76% D.P.	84,000	79% D.P.	72,000	85% D.P.
2⅞ Inch EU P 105	141,000	98% D.P.	133,700	104% D.P.	125,000	118% D.P.	118,000	140% D.P.
2⅞ Inch Drill Pipe "E"	144,000	.....	128,400	.....	106,000	.....	84,000	.....
3½ Inch EU N 80	148,600	64%-13.30 lb D.P.	133,200	65%-13.30 lb D.P.	112,000	67%-13.30 lb D.P.	88,000	66%-13.30 lb D.P.
3½ Inch EU P 105	201,000	87%-13.30 lb D.P.	189,500	92%-13.30 lb D.P.	174,000	104%-13.30 lb D.P.	159,000	123%-13.30 lb D.P.
3½ Inch 13.30 lb Drill Pipe "E"	231,000	.....	205,100	.....	168,000	.....	129,000	.....
3½ Inch 15.50 lb Drill Pipe "E"	263,000	.....	235,300	.....	195,000	.....	156,000	.....

to the various sizes and types of pipe for all depths up to the setting limit. The graph may be further used if greater than hanging load is applied to the pipe merely by converting this load to the equivalent of free pipe depth. Table 3 is a tabulation from Figure 3 for comparative figures.

It can be seen from a study of Figure 2 and Table 2 that from a load (tensile) carrying standpoint:

a. 2⅜-inch EU N-80 tubing is stronger than 2⅜-inch Grade E drill pipe below 14,500 feet.

b. 2⅜-inch EU P-105 tubing is stronger than 2⅜-inch Grade E drill pipe at any depth and is stronger than 3½-inch Grade E 15.50 # drill pipe below 15,500 feet.

c. Other similar comparisons are readily seen by a further study of Figure 2.

A last item of interest in the choice of a successful drill pipe for slim hole work involves clearances. Since the bore of the tubing and tool joints is streamlined, no restriction exists and the ID is greater in all cases than that of comparable size drill pipe and tool joints. Therefore, all inside work can be accomplished with standard and larger size tools while ample clearance is maintained.

This is of further advantage from the standpoint of hydraulics as well as metal to metal clearance. The pipe OD is the same as comparable drill pipe but the OD of the tool joints favors tubing. Aside from the hydraulic advantage, there will be minimum clearance problems in fishing operations. Standard overshots, cutters, wash pipe, backoff tools, and similar devices can be successfully used. It is further noted that both fishing tools and techniques have improved in recent years. —**The End**

Watch Your Minutes!

. . . because on a drilling rig, seconds can spell dollars . . . either lost or gained.

By J. PAT KIDD, Delta Drilling Company, Tyler, Texas

WHAT DOES a drink of water have to do with drilling a well? Nothing, you might think, but getting a drink of water, or any other similar insignificant chore that takes the same amount of time, can possibly mean the difference between keeping a rig stacked or busy.

Suppose a contractor has a rig that costs $1000 per day to operate on a 10,000-foot well that will take 60 drilling days. Now, every hour on the hour of each tour, the driller leaves the brake, (assuming that the bit will not drill off) walks over to the doghouse and spends one minute getting a drink of water. That is 24 minutes a day, and in 60 days the drillers have used up 1440 minutes while drinking water. This amounts to 24 hours, or one full day of rig operations at $1000 per day. On the 10,000 foot well, each $1000 affects the footage price at the rate of 10 cents per foot.

Minutes Important. This may be an absurd comparison, but it should show how important minutes can be on a drilling rig. Minutes can be lost any number of places. For example: when greasing the rig, cutting off the drill line, changing tours, making minor adjustments and, most important of all, when making trips to change bits. This is the one that is abused the most. When the crews on a drilling rig start "splitting tours" on trips, there will certainly be lost time.

First off, drilling bits just do not wear out regular enough to enable the tours to divide up the trip time. Consider the case of where for the last hour before the bit was pulled, the driller had to "baby" the bit so he could start out of the hole and have the new bit on by the time the next tour drove up.

Possibly, the bit was drilling at only one foot per hour less than it did during the last few hours it was run. But, if the bit had been averaging a drilling rate of 10 feet per hour, then better than six minutes were lost during that last hour. Multiply that by the number of bits used on a 10,000 foot well, and those few minutes have added up to hours.

Next to lost time while making round trips would be shutting down for greasing up operations. Here, the driller can shut down just long enough for the roughnecks to grease the connections that are close to moving parts, then go on and drill while they grease up the rest of the rig, or he can shut the rig down while it is completely greased. Five to 20 minutes per tour could easily be lost here.

Money Talks. The problem that faces a drilling contractor when considering lost time on a rig, is how to get the men to understand that minutes are important. Probably the best way is to show them how it can affect their pay check, for most of them are not roughnecking just because they have a deep undying love for the oil fields; it's because they appreciate the earning power it offers them. But what kind of earning power do they have when the rig they are assigned to does not work for over 6 to 9 months a year. Therefore, not only does a stacked rig hurt a drilling contractor, but it hurts the men and their families who depend on that drilling rig running. Possibly, there is the key to the whole situation. The men must work as efficiently as possible so their management will have a good yardstick to measure by when bids are made on the next proposal.

As for all the factors that go into the figuring of a bid, such as roads, mud, trucking, bits, hole size, etc., it is not deemed necessary to explain in this example. For the purpose here, it should be sufficient to assume that the rig is going to cost $1000 per day to operate; this will keep all the figures in round numbers and be much easier to use.

Going back to the above example of the $1000 per day rig on a 10,000-foot well, we can see that the contractor is faced first off with bidding properly to get the contract. If the contractor assumes that, normally, it will take 60 days to drill the well at the rate of $1000 per day, his expenditures will have been $60,000 or, on the basis of a 10,000-foot well, it will amount to $6.00 per foot actual drilling cost.

To go on with this assumption, the contractor will assume, for example, that he needs a $200 per day profit. Putting this in terms of a footage price, this amounts to $1.20 per foot for profit. This totals up to $7.20 per foot the contractor must bid to enable him to pay his expenditures and make some $12,000 profit. Even this $12,000 profit is not too large, considering the fact he will be using better than $250,000 worth of equipment to drill the well. But, from past experience, in the particular area where he is bidding on this 10,000-foot well, the contractor knows that to get the contract, he is going to have to bid in the range of $6.25 per foot. If everything goes according to schedule, and the well is drilled in 60 days, he will come out with $2500 profit.

But, at the same time, there is no room for any mistake. Even a very small fishing job would cost him severely; therefore, he will either have to include a safety margin in his bid, or else bid low and hope all goes well. What he will probably do is try to see where he can save days and then bid low enough to obtain the contract. But, suppose his men thoroughly understood the economics of the situation and could help out by reducing lost time to such an extent that one hour a day could be saved. This would amount to some 2½ days or $2500. This would certainly give

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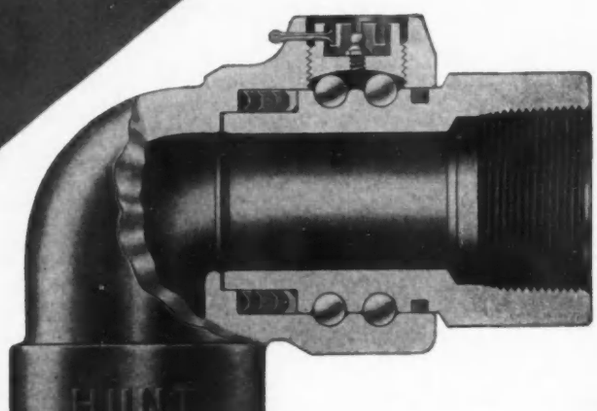

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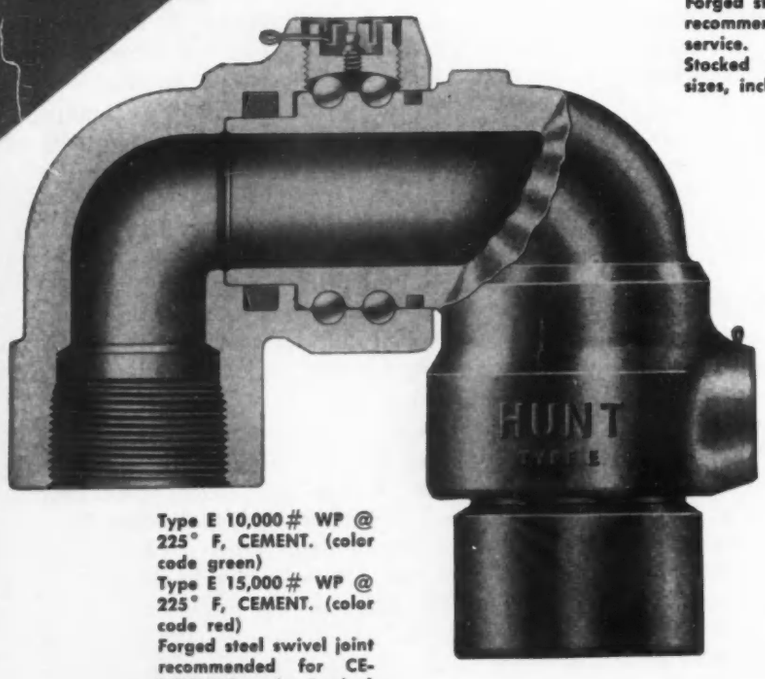

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a contractor an added edge when bidding on a well.

How Are Crews Affected? First off, for every day saved on a well, a roughneck loses a day's pay. How many times has a roughneck said to the toolpusher, "Let's stretch this well out another day or two; I need the money." What he does not realize is that by doing this, he is defeating the whole system under which his management bases his bids. If he knew the economics of the situation, he would know that for every day saved on a well, his management can deduct one day of operational costs from the well; therefore, the contractor can become more competitive when submitting his bids, and certainly will have a much better chance of keeping his rigs busy.

Therefore, the whole situation boils down to the fact that even if the roughneck loses a few days per year because he and the others of his crew carried on their daily operations more efficiently, he may gain weeks or, possibly, months more work merely because lower bids could be submitted by his management.

By making a few more assumptions, let us see how rig crews can be affected by using the same rig and well conditions as above, and assuming that to get a bid the drilling contractor would have to bid $6 per foot. The contractor figures that he can drill the well in 56 days, so he bids accordingly, and receives the job. After using 60 days, spending $60,000, and receiving a like amount for footage work, he sees that he has broken even. (Rigging up, tearing down, and daywork considered break even for simplicity).

But, suppose one hour per day could be saved by the crews operating more efficiently. This would amount to some 2½ days, which will not only allow him to take another contract at the same price, but would keep some 15 men working for two more months. As drilling techniques in that field are improved, the contractor may even increase his drilling rate, thereby increasing his profits as well as keeping his men busy.

Toolpusher Is Key. Of course, the toolpusher is the key to this whole situation. His rig crews are not going to be any more efficient than he is. Therefore, the toolpusher is the one who is going to have to pass information on to the crews, and he certainly cannot if he, himself, does not know all the factors that will influence getting work for his rig. If he realizes how the minutes that are undoubtedly wasted each day on a drilling rig are reflected into the bids made by his management, he will be able to help correct these problems.

Certainly, he will be able to clear up the minds of the roughnecks who feel that a day's pay in the pocket is better than taking a gamble on a few months work.

It should be understood that the minutes lost on a short contract are just as important as the minutes lost on a contract that takes months to drill. In passing, it might be worthwhile to mention that time is just as important when a rig is working on daywork, for an operator certainly observes the type of men a contractor employs; if he sees a contractor who employs men who loaf, he will hesitate about submitting another proposal to that particular contractor.

The examples that have been used are certainly not the way a contractor figures a bid; also, the time spent rigging up and tearing down and the time spent on daywork rates have all been ignored. It is felt that too little information is passed on to the men in the field who, after all, are the ones who will carry out all the plans and try to accomplish what is called for by their management.

It seems that one of the answers to this problem is showing them how just a few minutes per day can affect their pay check. As for the contractor, maybe an old phrase adapted here might explain something. Watch the little things, and the large ones will take care of themselves. In other words, watch the minutes, and you have taken care of the hours.

—**The End**

About the Author

J. PAT KIDD served in the South Pacific as a U. S. Army Air Force captain prior to attending the University of Oklahoma where he received a B.S. degree in petroleum engineering in 1949. After graduation, he joined Delta Drilling Company. Since then his assignments with Delta have covered varied phases of both drilling and production and he is now chief engineer. He is a member of the AIME, NGAA, Associate member of IPAA, a registered professional engineer in the State of Texas, and a member of Pi Epsilon Tau. Kidd is presently serving on the API Jet Bit Committee in the Ark-La-Tex area.

See Current Outlook, Production, International sections for other articles of interest on drilling progress

What's going on

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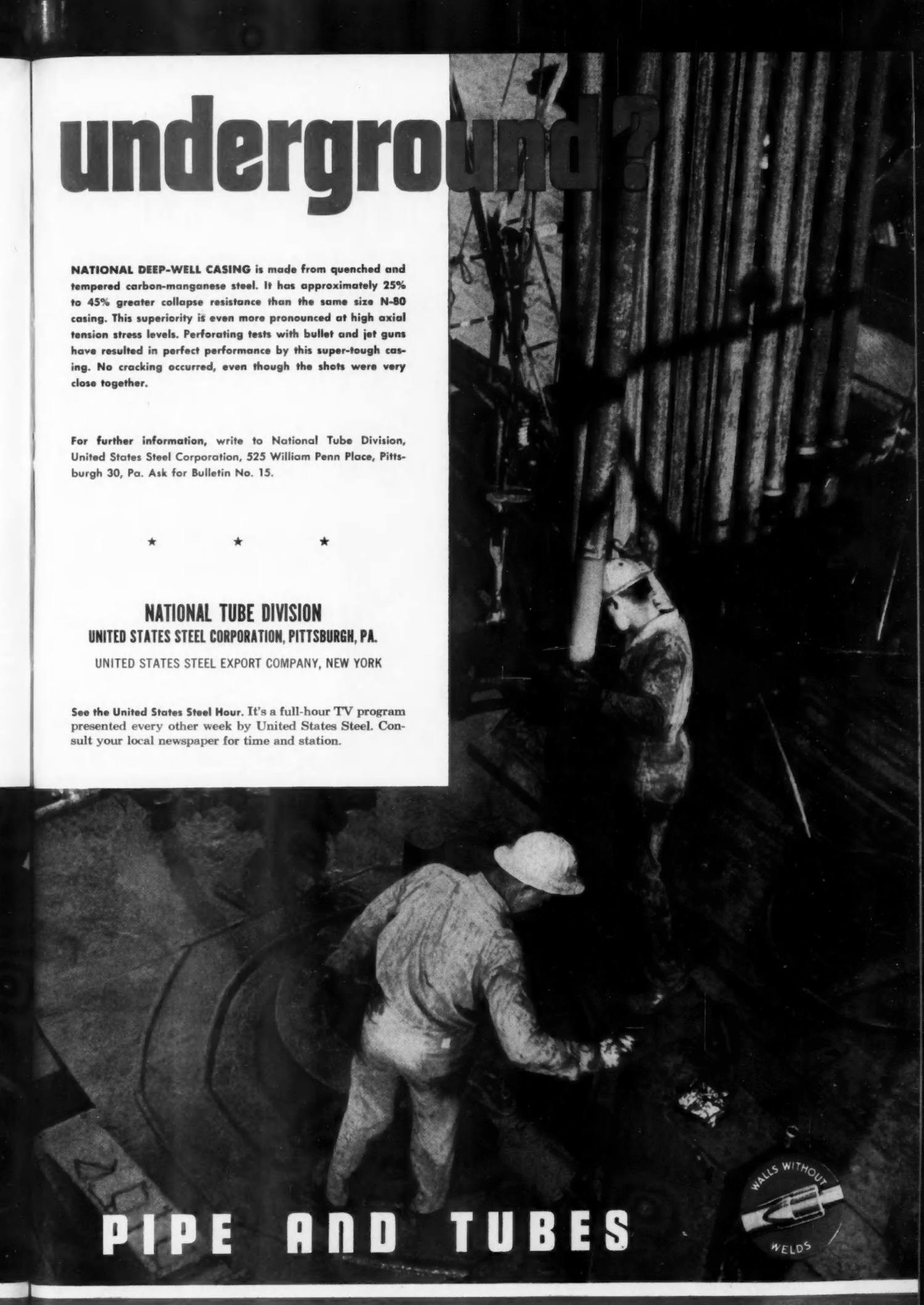


PIPE AND TUBES

UNITED STATES STEEL

How to do it

DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

Hoist Speeds Pump Suction Adjustment

Time and trouble will be eliminated by the connection of a chain hoist to the pump suction.

Undoubtedly, pump suction adjusting devices are one of the most varied and generally most ineffective rigs on location. Especially in deep drilling operations where lost circulation or abnormal pressures may be encountered, it is important that a simple, yet effective adjusting device be attached to the pump suction. Here is an idea showing how pump suction adjustment can be simplified.

The illustrated hoist is swung from a 4-inch pipe boom extending horizontally from a 6-inch support post connected to the pump skid. The 6-inch post extends approximately 18 inches above the boom to permit attachment of a ¾-inch rod support. The rod support connects to the end of the boom to assure maximum stability.

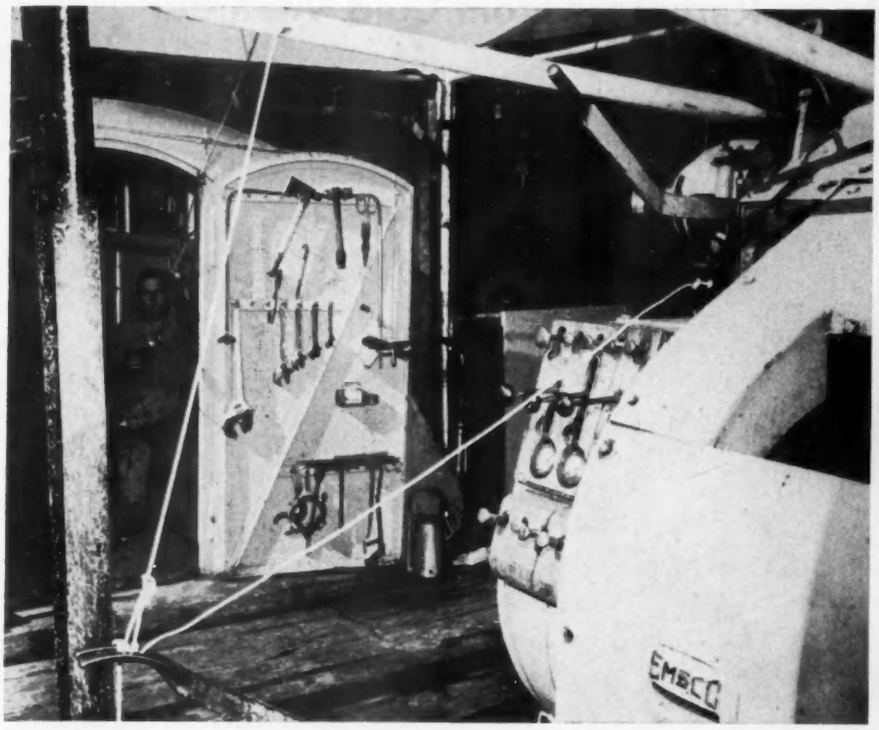
Three-quarter inch rod is shaped and welded below the boom and atop the suction line to facilitate joining the hoist between the two members. Fine adjustment of the pump suction is then possible with the expenditure of little time and effort.

In troublesome areas, the operator can attach a metal flag six inches or a foot above the mouth of the suction line. Then, since it is possible to raise or lower the suction line fractions of an inch, the operator will have a controllable flag which will be of special value when lost circulation, salt water flows or blowouts are a threat.

Sub-Storage Rack Permits Quick Selection of Tools

To have all subs, adapters, cross-overs and similar special fittings laid out in a usable and readily-accessible condition, equip one of the rig pipe rack sections with a small permanent sub rack in which each piece can be separately mounted in a near-upright position. Protect the bottom half of the storage rack by a strip of expanded metal to prevent shorter subs from falling on through, and separate each sub by a stud made of salvaged sucker rod material.

Stored in this partially-sheltered, yet readily accessible position, the subs can be inspected frequently, threads doped or bodies painted as necessary. The ability to check sizes, threads and other dimensions of a sub quickly can result in rig time savings that easily repay the slight cost of the sub rack.



Rope Provides Remote Control of Brake

When necessary to keep close tab on the drilling rate in minutes per foot and the weather makes it necessary for the driller to remain inside the doghouse, a simple rig may be provided to feed off the drill pipe maintaining constant bit pressure.

Three pieces of sash cord are used. With one piece, weights are tied to hold the brake lever down; with another piece, the brake lever is tied up to a screen door spring; and the third piece is run through a small pulley above the brake and into the doghouse. The driller can remain in the doghouse and feed off the drill pipe with the required weight showing on the weight indicator dial.

Adjustable Legs Support Doghouse Attached to Rig

One drilling company in West Texas has adapted adjustable legs for the doghouse attached to the rig.

Two legs, each adjustable to the terrain encountered, support one end of the doghouse. The other end of the house is attached to the derrick floor.

Inexpensively made from scrap five-inch pipe, the outer shell of the leg has holes drilled at regular intervals from the bottom nearly to the top. An inner pipe, of smaller diameter, has holes of similar size drilled along the lower end.

The inner pipe is raised or lowered so that the doghouse floor is level, and a metal pin is inserted through holes in both the inside and outside pipe to hold it in position.

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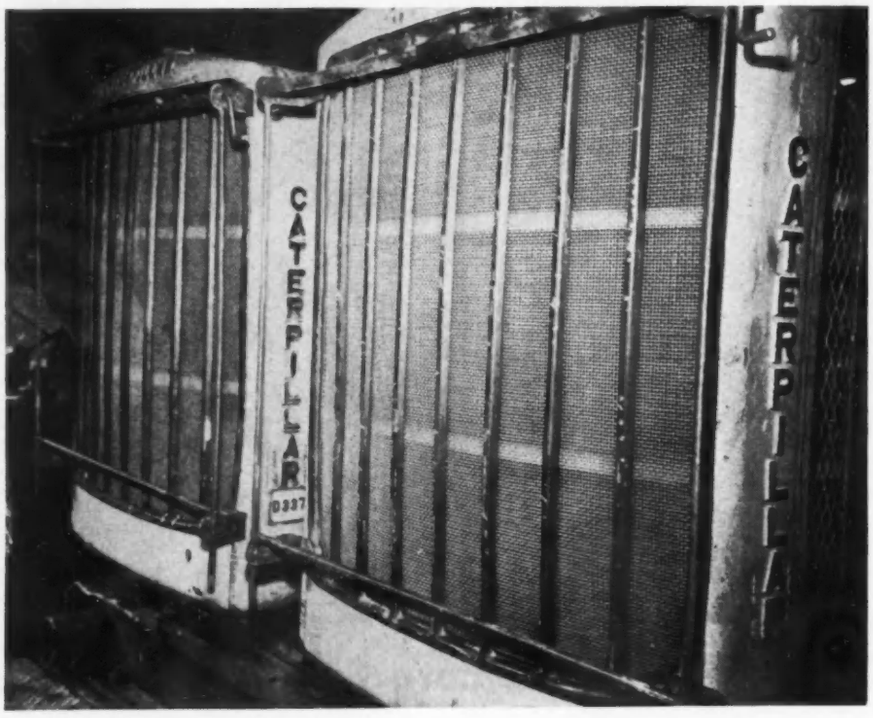
Simple Framework Protects Radiators From Cold Weather

With the approach of cold weather, some thought should be given to protection of engine equipment. A simple framework may be made which fits onto the existing bolts on the radiator front.

The frame is made rigid with ½-inch steel bolts welded to the brackets which fit the bolts in the corners of the radiator guard. The only movable parts are the rods which slide up and down on the side pieces and the ⅜-inch pipe with a crank on the end which turns inside the bearing at the top.

In operation, the canvas is fastened to the roller at the top and then down around the sliding rod at the bottom. The crank can be turned to adjust the height of the canvas curtain according to engine temperature and outdoors temperature.



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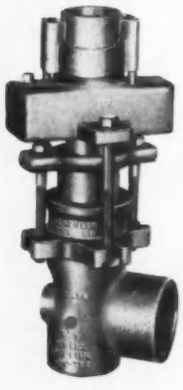
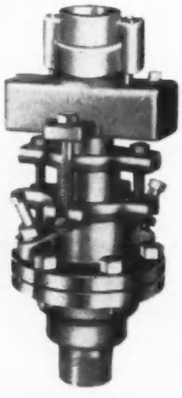


"TEE BASE TYPE"

The three illustrations show all the famous HERCULES Duplex Polished Rod Stuffing Boxes equipped with the New Oil Reservoir Upper Gland.



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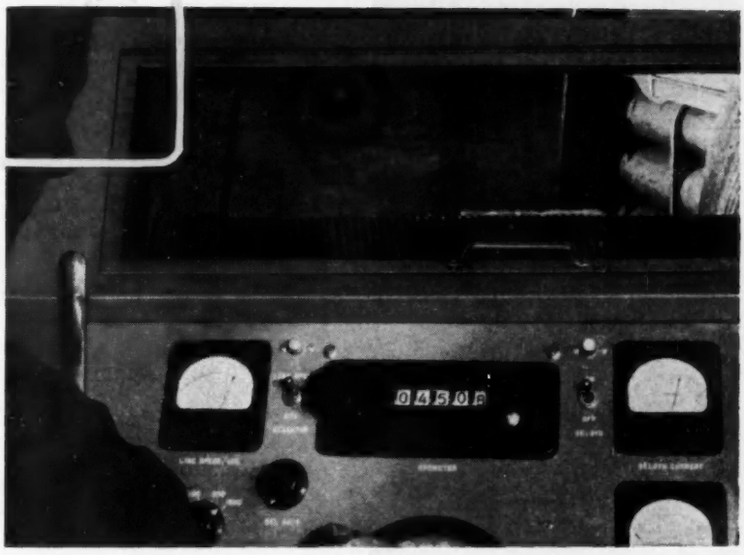

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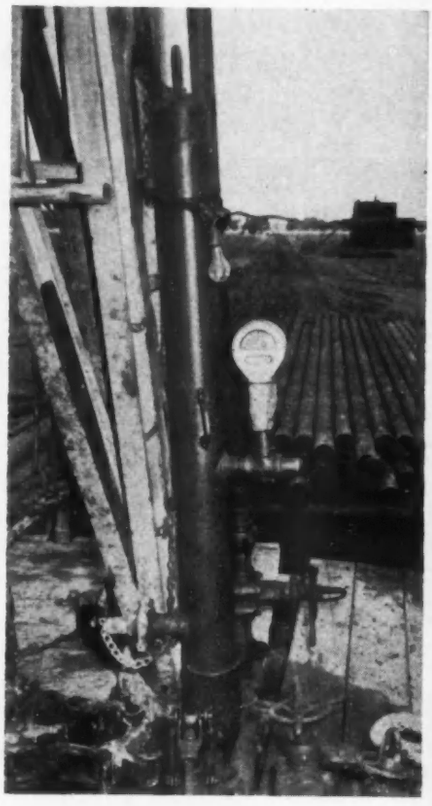
Weld a connection in the side above the liquid line for the pressure gage to prevent it from being contaminated with drilling mud. Make another connection on the opposite side with a quick acting union and a bull plug for making a quick connection to the well head. To keep it handy, attach the bull plug to the chamber with a chain.



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On slim hole rigs where the derrick floor is low, it is necessary to raise the tool house only a foot or two from the ground. To gain this height, yet have a compact load, a stand can be made which folds back under the doghouse

and makes into a skid when the doghouse is loaded.

The front end of the floor of the doghouse has a 3-inch piece of pipe welded fast and a 2½-inch piece fitted inside the legs the height of the derrick floor. A removable brace is made to hold the legs erect by taking a piece

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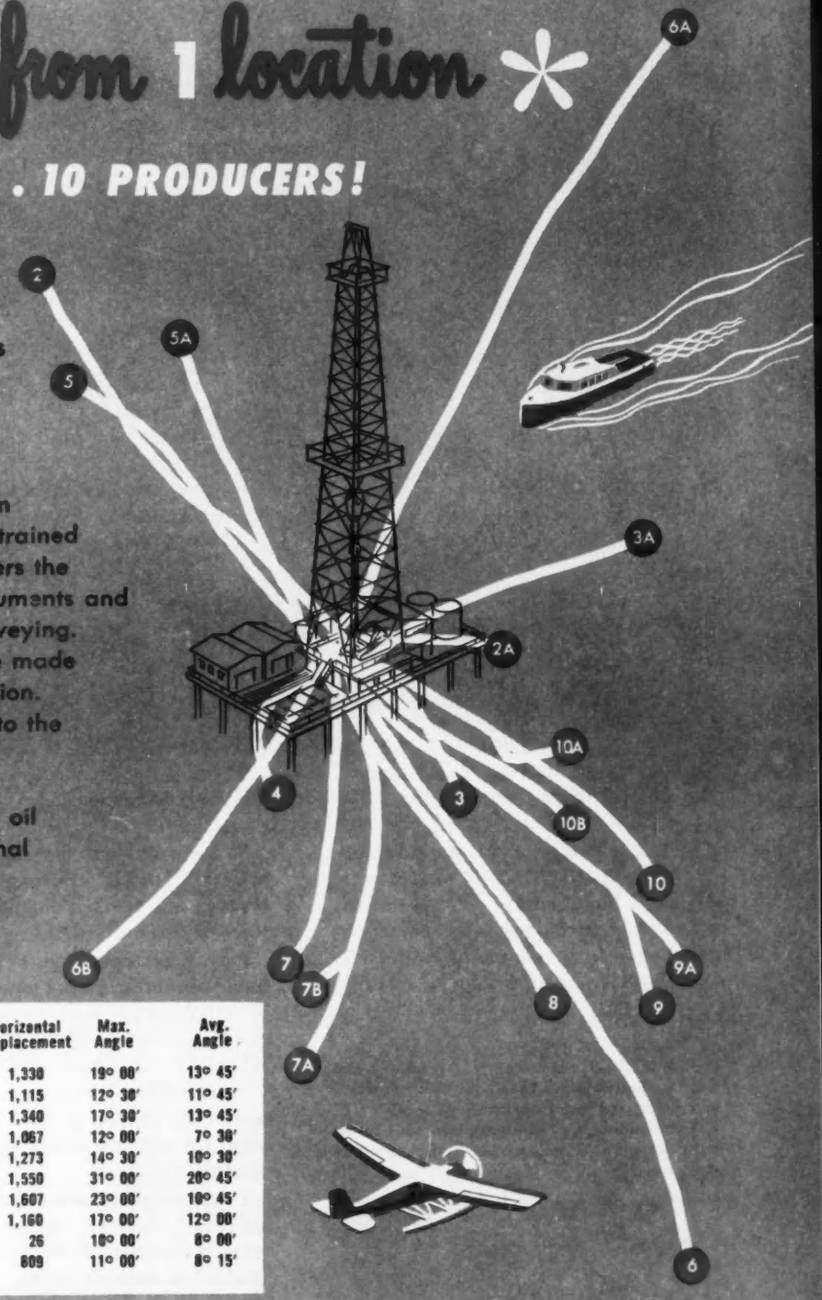

* LEGEND

Well No.	Horizontal Displacement	Max. Angle	Avg. Angle	Well No.	Horizontal Displacement	Max. Angle	Avg. Angle
1	vertical			6B	1,330	19° 00'	13° 45'
2	1,600	23° 00'	16° 30'	7	1,115	12° 30'	11° 45'
2A	400	9° 00'	6° 30'	7A	1,340	17° 30'	13° 45'
3	490	8° 30'	7° 00'	7B	1,067	12° 00'	7° 30'
3A	1,000	17° 30'	14° 00'	8	1,273	14° 30'	10° 30'
4	470	10° 00'	8° 45'	9	1,550	31° 00'	28° 45'
5	1,267	31° 45'	25° 00'	9A	1,607	23° 00'	18° 45'
5A	1,070	16° 00'	10° 15'	10	1,160	17° 00'	12° 00'
6	2,417	44° 00'	31° 00'	10A	26	18° 00'	8° 00'
6A	2,412	30° 00'	23° 45'	10B	809	11° 00'	8° 15'

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Tips on Mud Valves for Toolpushers . .

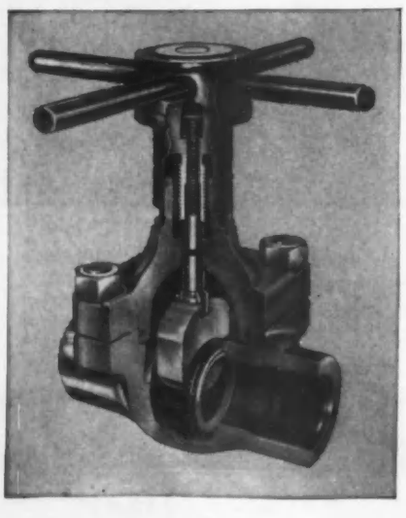
"Buck" Dotson standing amid eight flanged end MUDWONDERS on the mud manifold of Big Chief Rig #32.

Rockwell-Built MUDWONDER Solves Operational and Maintenance Problems

by S. T. "Buck" Dotson, Toolpusher
Big Chief Drilling Company Rig #32, Garvin County, Oklahoma

OUR first encounter with the Rockwell-Built MUDWONDER was several years ago. Big Chief Rig #29 was selected as one of the testing rigs to use, abuse, and prove the performance of the MUDWONDER in the field.

MUDWONDER cut-away view shows the double thread construction, separated stainless stem and hard chromed gate with "T" slot connection and the one-piece seat insert with the buna-N molded integrally over the steel wear rings.



So successful was our experience that MUDWONDER was specified for all mudline valves when our new Big Chief Rig #32 was ordered.

Easy, quick operation, even under extreme pressures, is a big point in favor of MUDWONDER. We never need a cheater and I have yet to hear about a MUDWONDER failing to operate.

The one-piece body is an important feature for us, too. It stays in place and keeps the line together when we inspect or replace parts.

Lower maintenance costs and easy operation are important on our rigs; so, we are now specifying Rockwell-Built MUDWONDER mudline valves.

I can recommend MUDWONDER to any toolpusher having mud valve trouble. MUDWONDER valves are built in 2", 3", and 4" sizes with screwed or flanged ends for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test).

Your favorite oil field supply store can give you complete information, or write Edward Valves, Inc., East Chicago, Indiana. Quick shipments can be made from East Chicago or the Edward Houston warehouse through the supply store you select.

By the way, Big Chief Rig #29 is still using that original valve. (Adv.)

HINTS . . .

of 2-inch pipe and slotting it to fit a plate welded to the side of the doghouse and the legs. Holes are then burned through the ends of the legs and the plates through which pins are fitted.

When time to move, the upper pins are pulled and the legs folded back, providing skids to facilitate loading and make the load more compact.

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Jones, Shelburne & Farmer of Russell, Kansas, weld a convenient steel tool box to the side of their pickup trucks providing ready access to spare parts, tools and wiping rags. Built from scrap materials, the unit can be removed easily and reinstalled when necessary.

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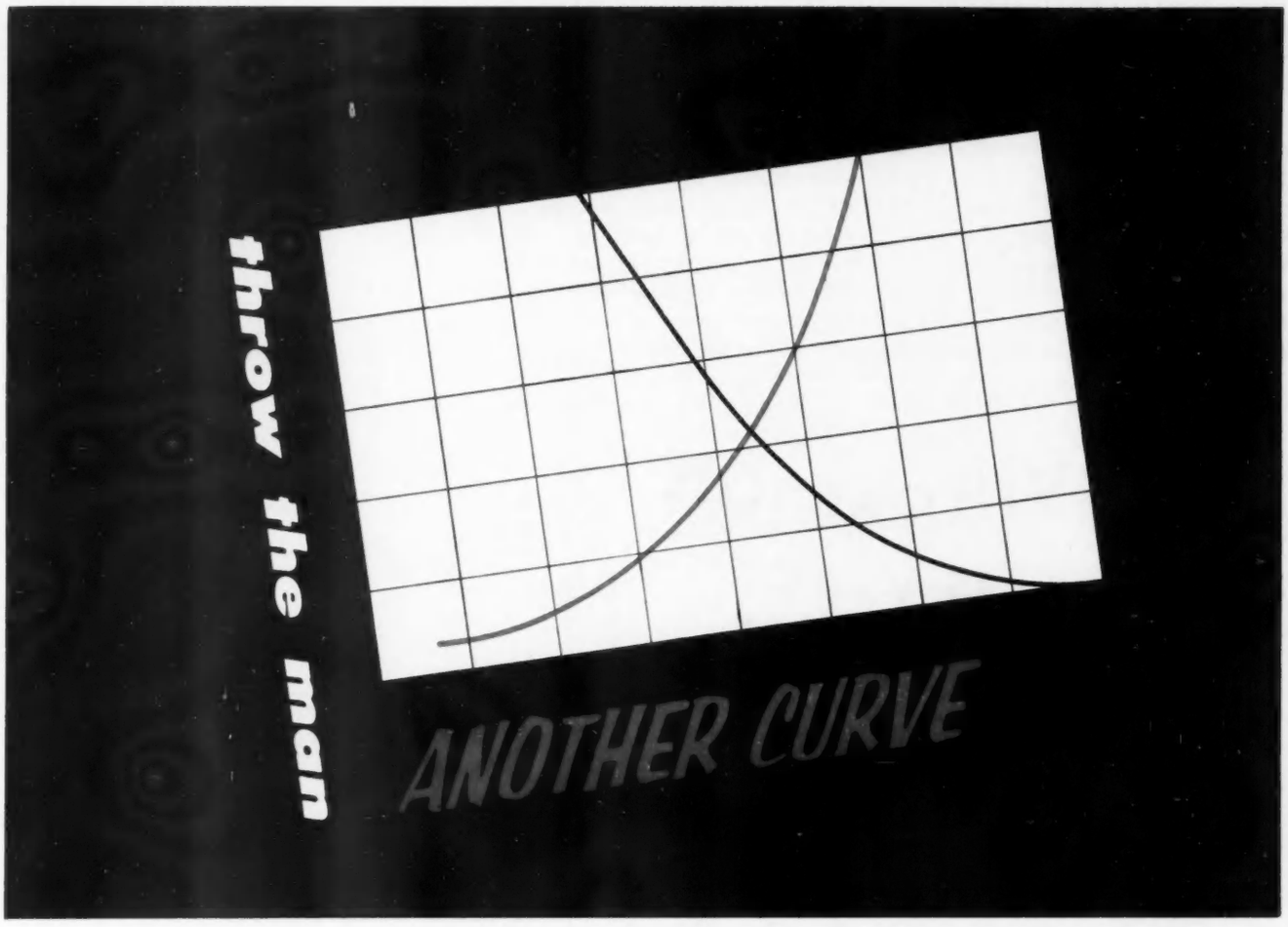
By mounting the tool box on the side, greater space in the main bed is available and all tools are handy to the workmen.



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Easy accessibility, cleanliness and good housekeeping are combined in this below-floor rack for storing of lifting subs. Designed to hold eight subs, the rack itself is a length of heavy angle iron mounted on brackets welded to a framework spanning below-floor sub-structure members in front of the drawworks. Depth of the rack is sufficient to allow ample clearance between lifting bails and the angle iron-stiffened, non-skid surface hinged cover, which lies flush with the surrounding floor. When closed, the cover becomes a part of the rig floor and is capable of withstanding the normal abuse of flooring in that part of the rig floor area.

The angle iron rack supporting the subs is notched, the slots being only slightly wider than the OD of the subs. Each of the rounded-end tongues is strengthened and supported by a triangular fillet welded beneath it. The unit easily is lifted out and replaced when the rig is moved.

The sub rack, besides being in a readily-accessible place, occupies otherwise unused space beneath the floor. Being below floor level, and covered over when not in use, the subs do not get splashed with mud, nor are as easily coated with sand and dust as they often are when placed in the typical exposed rack near the outside edge of the rig floor.

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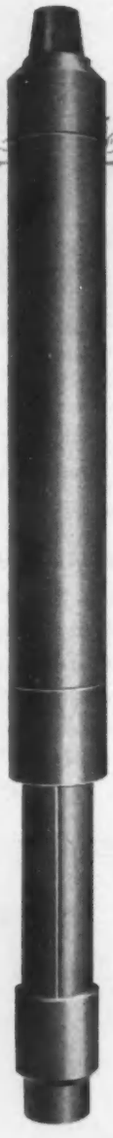

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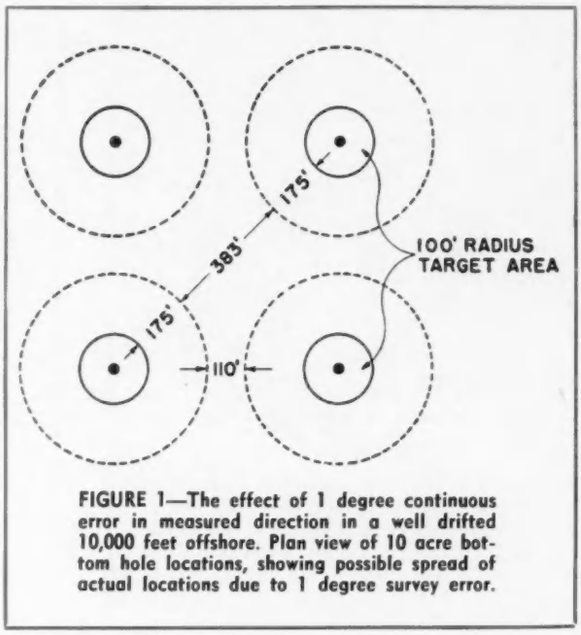

FIGURE 1—The effect of 1 degree continuous error in measured direction in a well drifted 10,000 feet offshore. Plan view of 10 acre bottom hole locations, showing possible spread of actual locations due to 1 degree survey error.

DIRECTIONAL WELLS

Here is the story of the experience gained by two operators during a 20-year program where 462 high drift directional wells, aggregating more than 500 miles of slant hole, were drilled in Huntington Beach area.

By DANIEL S. JOHNSTON, Signal Oil and Gas Company
and **JAMES T. CARRIEL,** Southwest Exploration Company

AN INCREASING number of oil wells are planned and drilled using the techniques of controlled directional drilling to develop production from a desired subsurface location.

This is a report on new concepts and methods developed primarily during the drilling and producing of high drift angle wells at Huntington Beach, Calif.

Huntington Beach, from the standpoint of direction drilling, is historically probably the most interesting oil field in the world. The development of the field spread rapidly after discovery in 1920 to an intensively drilled town lot area adjacent to the Pacific Ocean. In May, 1930, one oil operator directionally drilled a well out under the ocean with neither permission to trespass under privately owned shoreland property nor rights to extract petroleum from state controlled tidelands. Other operators followed suit, and an active drilling campaign ensued.

This practice was stopped by injunction in September, 1933, and all operations were placed under the jurisdiction of the California Division of State Lands.

Control of direction angle in a high drift angle hole is one of the major problems. The removable whipstock is still the basic tool of control, and with it the operator must accept the increased hazard of a fishing job. Direction angle change in the offshore pool at Huntington Beach, however, can definitely be influenced by different designs and combinations of drilling bits and reamers. Although not representing complete direction angle control, variations of bit and reamer designs and combinations do eliminate some whipstock runs. Most high drift angle holes have a tendency to drift to the left or right rather than follow a straight line course in direction. Huntington Beach wells in most cases exhibit left hand tendency. By constructing a proposed course that allows for this drifting tendency, many whipstock runs can be avoided. Any cylinder restriction around the proposed course should be as flexible as possible. This also can eliminate some whipstock runs. Other methods of control are being studied. Alternate left and right hand rotation of the drill string shows much promise. A locked drill pipe tool joint essential to alternate rotation has been designed and tested in the field.

Problems in surveying, not critical in low angle directional wells, have to be overcome in high drift angle holes. The surveying instrument on a sandline will not drop to bottom and must be pumped down using a stuffing box and swivel arrangement. The accuracy of surveying a high angle directional well with a small compass is debatable. Figure 1 illustrates the effect of 1 degree continuous error in measured direction in a well drifted 10,000 feet offshore. The 175 foot total error can make an

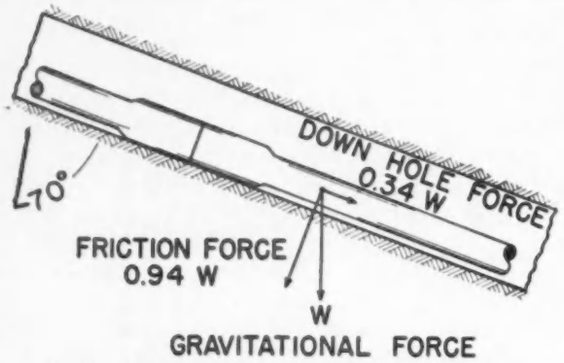

FIGURE 2—Force diagram in 70 degree angle well.

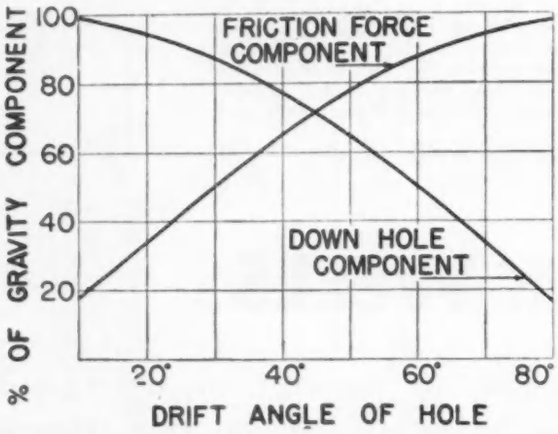

FIGURE 3—Plot of force diagram for various drift angles.

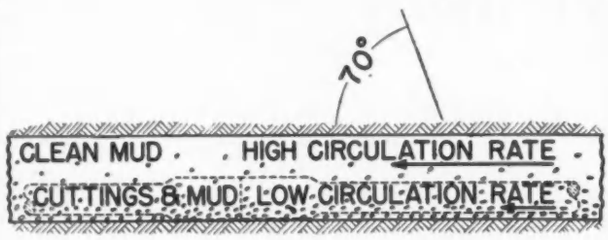

FIGURE 4—Circulation distribution in 70 degree angle well.

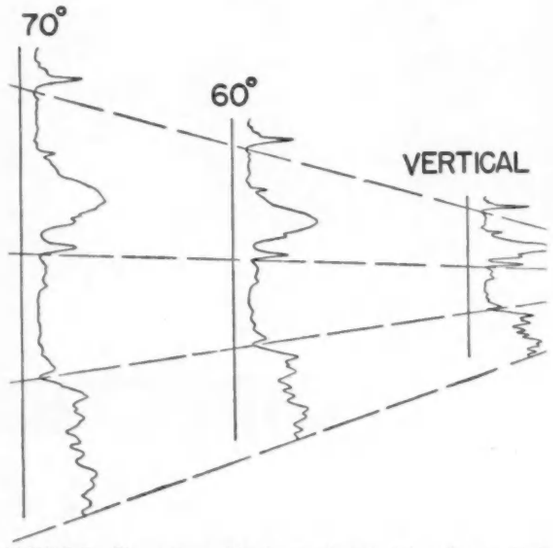

FIGURE 5—Elongation of beds on electrical log due to high angle of penetration.

appreciable difference in actual well spacing in a ten acre pattern. Drift angle error also can be cumulative in the same magnitude. Instruments are changed at regular intervals to reduce the probability of cumulative error in one direction.

Mechanical Problems. Two basic conditions in high drift angle holes create major problems which are generally minor or non-existent in straight holes:

1. Only a small portion of the weight of the drill string is available for moving the tools down the hole. Over 90 percent of the weight of the drill string is bearing on the low side of the hole as a friction force component (Figures 2 and 3.)

2. Circulation in high angle holes is similar to flow along a stream bed. Cuttings are washed along the low side of the hole at slower than the average circulation rate; and clean mud channels on the high side of the hole at faster than average circulation rate (Figure 4).

From these two conditions stem problems which had to be resolved for successful high drift angle drilling.

Drilling pipe rotating with almost its full weight bearing on the low side of the hole soon wears key seats in the soft formations. These key seats are worn to the size of the drill pipe tool joints. For this reason the diameter of the tools run in the hole becomes critical. Drill collars with the same or smaller diameter will follow through key seats. Drill collars slightly larger than tool joints will partially lodge in key seats and often stick. Drill collars considerably larger in diameter will ride over key seats and minimize sticking hazard. Skillful drillers can avoid pulling into key seats most of the time. One of our larger power rigs transmits all power to the drawworks and pumps through dynamatic couplings. Horsepower input to the hoist, rotary table and pumps can be smoothly regulated from zero to maximum. In pulling drill pipe, only sufficient horsepower is transmitted to move the pipe. Any increase in load requirements due to key seat friction will instantly stall the drill pipe without pulling into the key seat.

A bumper sub is carried immediately above the drill collars and sometimes others are placed at selected intervals up the string of drill pipe. Usually the tools can be bumped downward out of a key seat. In case of unrecovered fish, sidetracking by undercutting is normally accomplished by repeated reaming and drilling above the fish.

As the weight of the drill string is mostly on the low side of the hole creating friction, rotation torque is greatly increased. This places a severe torsional strain on the drill pipe and also makes difficult and transmission of a known amount of turn to the bottom of the drill string. By taking out only the horsepower needed for actual rotation through the dynamatic couplings, drill pipe twist-offs have been minimized by elimination of sudden loading.

A program of periodically reaming

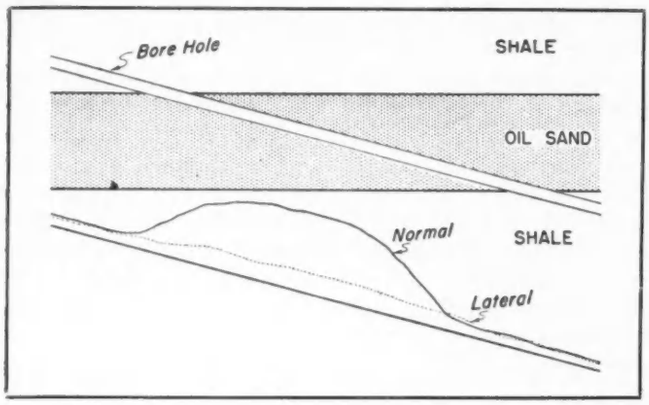

FIGURE 6 (left)—Effect of high angle on lateral resistivity measurement.

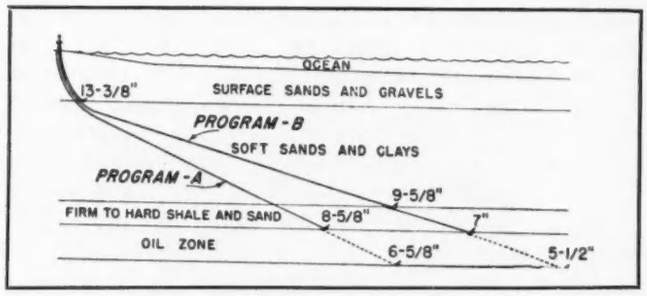

FIGURE 7—Well course with casing programs "A" and "B".

the hole helps to smooth out the key seats. Tight spots are also reamed with the drilling tools when running in the hole.

The problem of key seats and tight hole might not be severe if it were possible to keep the hole and drilling tools clean.

As an aid in keeping the hole clean, the following practices have been adopted:

1. High circulation rates are maintained.

2. When pulling out of the hole, circulation is established at several depths to circulate the cuttings up the hole in stages.

3. The properties of the high pH oil emulsion mud are carefully controlled to maintain maximum carrying and suspending properties.

Drill pipe wear is another major problem resulting from rotation under great friction without adequate circulation. As the pipe rotates in a medium of abrasive sand cuttings with 90 percent of its weight supported by the mostly abrasive wall of the hole, tool joints and tubes receive rapid and extreme wear.

Unprotected tool joints can wear beyond repair during the drilling of a single well. After testing many metal compounds and application methods for tool joint protection, the answer was tungsten carbide applied by welders using acetylene. Fingers of tungsten carbide are laid in grooves along the 18 degree taper at right angles to the band. Maintenance of tool joints at maximum diameters by regular rehardfacing virtually eliminates tube wear. Other methods of drill pipe tube protection used are:

1. The unprotected tool joint is allowed to wear to a minimum diameter and then is replaced with a new tool joint.

2. Wear subs are inserted between the pin and box of the tool joint. Upon wearing to a minimum diameter, they are replaced or resleeved.

The drill pipe is also inspected for shoulder wear on the box with a minimum gage for damaged threads and for tube straightness. A crooked tube of drill pipe can be worn out by one trip in the hole and during the dulling of one bit.

Surface Pipe Protection. Thirteen and three-eighths-inch casing is cemented in the curved portion of the hole and consequently is subjected to considerable wear from the drill pipe. Although drill pipe rubber protectors are used, the casing shoe and bottom few joints are in contact with drill pipe steel during rotation. Also in round tripping, the hard faced tool joints move through the casing usually along the same path.

The use of a special casing shoe was adopted after regular shoes were worn through on two wells. This shoe is extra long and has a wall thickness of 1¼ inch. None of these special shoes has worn through, but in one instance the shoe joint was worn through while the shoe remained intact. Subsequent practice has been to weld 2-inch steel bands 2 feet apart along the entire length of the bottom two casing joints.

Hard faced drill pipe is never used in the surface casing. Oversize twin pin wear subs are used in the connecting drill string between the rubbered drill string in the casing and the hard faced drill string in the open hole. These wear subs must be resleeved to maximum outside diameter with regular tool joint steel at frequent intervals.

Electrical Logging. The electrical log is the basic tool employed in the Huntington Beach field to evaluate and correlate possible productive zones. Accurate fluid content determination and correlation of marker beds from the electric logs are usually possible. However, interpretation of high angle well logs is complicated.

Figure 5 illustrates the elongation of formations recorded on the electrical log for 60 degrees and 70 degrees drift angle wells penetrating horizontally bedded sands and shales. If the formations have a dip component in the same direction as the well course, the elongation factor will approach infinity. Two wells have actually penetrated progressively younger beds for several hundred feet.

Another problem in electrical log interpretation results from the low relative angle between the well course and dip of the producing zones. Figure 6 shows electrical logs through a thin oil sand between two shales as recorded in a straight and in a 70-degree hole. The low apparent resistivity measured by the lateral device in the high angle hole is a typical phenomenon. This effect must be taken into consideration for correct interpretation of the log.

With the aid of service companies, a means of taking an electrical log with a special sonde attached to the bottom of the regular drill string was developed. This procedure uses 94-foot, six-conductor, neoprene insulated cables with vacuum seal rubber connectors. While pulling out of the hole to log, an extra rotary helper drops a cable into each stand of drill pipe as it is set back in the derrick. Every cable is supported by a steel cage which rests on the shoulder inside of the tool joint at the base of the box thread. Wire from the electrodes on the sonde are brought into the drill through a fluid tight adapter

sub and connected to the bottom conductor through a relay. Electrical continuity between the cables and the sonde is broken by means of the relay. This allows an instant test for detection of faulty cables immediately after each connection is made.

During logging operations the cables inside the drill pipe are connected to an armored cable leading to the logging camera. Depth measurement is controlled by running the armored cable over a measuring sheave.

As the conventional hoisting truck and wireline are not needed in this method, it could be adapted to other types of drilling where transportation and standby expense are problems.

Running Casing. Early experience at Huntington Beach indicated that serious hole trouble is apt to develop after about thirty days of open hole drilling below the surface casing. The soft clays and sands tend to disintegrate and cave after continued exposure to the drilling fluid. Key seating becomes critical. As a result, a casing program was designed to limit the length of open hole carried to 7100 feet, the footage usually drilled in about 30 days. In wells for which 8300 feet total depth is sufficient to shut off all water above the oil zone, Program "A", Figure 7, is followed. If water zones are still open above the oil zone, Program "B" is followed.

Another alternate casing program used is a combination of "A" and "B." An attempt is made to cement the 8⅝-inch water string on top of the producing zone regardless of the depth. In the 8⅝-inch casing sticks off bottom, a 7-inch flush joint liner can then be run and cemented at top of the producing zone.

As shown in Figure 2, only one-third of the casing weight is effective for moving down the hole, while over 90 percent of the casing weight is bearing on the low side of the hole. Certain considerations in casing design and running procedure were, therefore, necessary.

Water strings and protection strings have been the most difficult to run in the hole; primarily due to the fact that from 8 to 16 hours are required to make up the casing and reach total depth. During the last 2000 feet to 4000 feet, the string must be picked up and released several times after each joint make-up, before the casing will move down the hole. Quick release thread protectors and air tongs are used to speed up the operation. Two methods have been developed to combat static friction between casing and hole. One casing centralizer is installed on every other joint for the bottom 50 joints to reduce static friction. A series of internal flush bumper subs in the casing string are used as an aid in breaking static friction after joint make up.

Seven-inch blank liners can be run in 8¾-inch, high drift angle hole only with great difficulty, unless provision is made for fluid passage inside as well as outside of the casing. Without sufficient fluid passage, the liner acts as a piston in close tolerance hole. The advantages of running the cementing tool at the same time as the 7-inch blank liner were also apparent. In order to satisfy both of these requirements, a special liner hanger was designed. Use of this hanger, in conjunction with a special float collar, results in adequate fluid passage around and through the liner. It also allows immediate cementing after the liner reaches bottom and the hanger is set.

Cementing. In high drift angle directional wells, cementing operations are similar to those in vertical holes provided one factor is taken into consideration: mud will channel on the high side of the hole bypassing cement, and conversely; cement will channel on the low side of the hole bypassing mud.

Cementing Casing. Surface casing, water strings and protection strings can be cemented in a conventional manner with the following precautions:

1. Large volumes of cement are used (600 to 800 sacks) to reinforce the casing for subsequent drilling and producing operations and to reduce the channeling effect near the shoe.

2. An 85 pound per cubic foot slurry is used for water strings and protection strings to reduce channeling and to decrease the hydrostatic pressure on the formation. Expanded perlite is used as the light weight additive.

Blank liners have presented more cementing problems. A successful job consists of displacing cement from the shoe to the top of the blank liner (2000 ± feet) in a manner which results in a cement seal between the protection string and the overlap of the liner. The channeling tendency between cement and mud resulted in four failures on the primary cementing of our first five jobs. Subsequent jobs have all been successful due to adoption of the following practices:

1. Lightweight cement, as near the density of drilling fluid as practical, is now used.

2. Overlap between 9⅝-inch and 7-inch casing string was lengthened to 400 feet from 200 feet.

3. The size and number of centering lugs which are welded at regular intervals around that portion of the 7-inch blank liner inside of the 9⅝-inch casing were increased.

4. Cementing can take place immediately after the liner is hung.

On five combination blank and perforated strings cemented, a primary shutoff was demonstrated on only one. Combination strings are no longer used except as a last resort.

Plugging Bottom. Conventional methods of plugging bottom water are not effective in high drift angle holes.

Present practice for bottom water plugs involves the use of an upwhirler cementing shoe on the bottom of blank drill pipe. The shoe is raised slowly during displacement of the cement. Gel is added to the cement to decrease shrinkage.

Testing for Water Shutoff. Wherever the effectiveness of a cement job must be insured, a water shutoff test is made. Tests for water shutoff are ordinarily made with a casing slip-type tester.

An open hole-type tester, run without a trip valve, can be set and opened by placing the drill string weight on bottom.

Completion Problems. Loss of circulation in varying degrees is common in the Huntington Beach Offshore pool. Some wells are drilled with full circulation, some will support an oil column without appreciable loss but will take mud, and others are drilled with oil without returns.

If circulation loss is severe enough for the cuttings to disappear com-

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Trying to increase barrels per day by the trial and error method of rod string selection is a sure-fire way of tossing money down the hole. Pictured is a sucker rod and coupling from a Southern California field. Incorrect specification of size or combination of sizes, improper choice of the type of rod for the well condition caused the failure.

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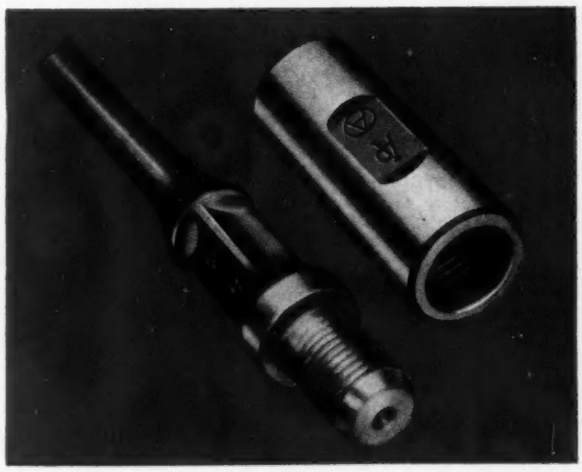

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pletely into the zone, no problem of well cleanup for production exists. However, later in the life of a well, these cuttings may cause producing problems. The wells with partial lost circulation present the major problem. In this case the cuttings will neither disappear into the zone nor circulate out with the reduced velocity of partial returns. Present practice is to drill ahead with oil, if circulation is lost, leaving the remaining mud column as a mud cap. If partial returns are obtained as drilling progresses, the volume of the mud cap steadily diminishes as the oil channels through it. In any event, cuttings will remain in the well, and are usually found strung out over almost the full length of the hole.

The following cleanup program has been used with satisfactory results:

1. An open-hole packer on the end of drill pipe is set at the top of the liner with a perforated sub above the packer. Below the packer a blank sub is used with the end designed to seat on top of the liner hanger. The entire hole above the liner can then be cleaned by reverse circulating any desired volume and velocity of oil. No back pressure is placed on the oil zone.

2. After the casing is filled with clean oil, circulation can often be established. In this case, blank drill pipe is run and the liner is cleaned up in 500 foot stages by reverse circulation. If circulation cannot be reestablished, the cuttings are driven down to the lost circulation zone by forcing oil away.

3. The well is then bailed until clean, using a bailer on the end of the drill pipe or tubing.

PRODUCTION

Surface Facilities. Most large installations of directionally drilled wells in California have the surface facilities of the wells lined up in a single or double line with individual well heads being from 12½ feet to 28 feet apart. This concentration in surface locations of wells makes possible a large saving in area and surface facilities, such as gathering systems, service lines, electrical facilities, roads, etc.

Concentration of surface well locations facilitates the maintenance of equipment, servicing, sampling and supervision of the wells. As personnel can readily handle more wells, producing costs are lowered.

At Huntington Beach, a certain group of 350 oil wells has a unique arrangement for the 16 production derricks. Each 96-foot derrick is equipped with four 6-inch railroad type wheels which run on railroad tracks embedded in the concrete mats. These derricks are so designed that they clear the top of any pumping unit in motion. A truck winch line is used to move a derrick over a given well to be pulled.

Flowing and Gas Lift Wells. Variance in the efficiency between a straight well and a directionally drilled one is small for flowing and gas lift production. Due to the viscous nature of the Huntington Beach oil no plunger gas lift has been tried.

Rod Pumping. Due to the depleted nature of the Huntington Beach producing zones, most of the wells, including those farthest out under the ocean, are produced with pumps. Sucker rod insert pumps are employed predominantly because all pump parts are removed when the rods are pulled.

As in drilling, rod pumping problems in directional wells are related directly to friction. The drop of the sucker rods, wear, and corrosion are all predominantly functions of friction. Rod pumping with certain adaptations has been possible on all wells drilled to date.

Future production trouble can be minimized by adequate clean up at the conclusion of drilling or remedial work. In one particular case, following inadequate cleanup, a string of rods was worn out in one day. Often it is found that the rods become badly worn only in the portion of the hole where the drift angle is high and where mud and sand are apt to remain on the low side of the tubing.

Where difficulty exists in making the rods drop, the condition can be alleviated to some extent by replacing the upper 2000 feet to 4000 feet of rods with larger diameter rods.

Tubing collar wear is negligible in shallow high drift angle wells because frictional forces between the tubing and casing prevent pulsation. However, excessive tubing collar wear has occurred in deeper wells with drift angles under 55 degrees. Use of tubing anchors has eliminated pulsation of the tubing. No anchor is required for wells with a maximum drift angle above 55 degrees.

Contrary to popular belief, corrosion is no more severe in directional wells than straight holes. Corrosion mitigating chemicals have been injected by annulus feed and have successfully reduced corrosive action.

Fluid Operated Pumps. Various installations of subsurface fluid operated pumps have been installed in directional holes in recent years and have given very satisfactory service. A fluid operated pumping system lends itself readily to installations of concentrated surface well sites and where space appearance are important considerations. Lower producing costs by their use is indicated by an increasing tendency to install them in high drift angle directional wells.

Technical Production Services. The physical nature of directional drilling places certain limitations on technical production services, involving runs into the wells through tubing or the annulus between the tubing and the casing. Friction impedes the running of bottom hole sampler, water locating device, temperature, pressure, and flow rate recorders. In directional wells above 60 degrees drift angle no instruments can be run below the buildup region unless they are run on tubing or rods. Annulus runs in low angle wells have been attempted but without success.

The inability to run a pressure bomb down a high angle well necessitates pressure determination by calculation from fluid level data. Where fluid levels are low, as at Huntington Beach, log extrapolations are unnecessary and accurate pressure data can be accumulated.

Three devices to help motivate instruments down a well have been designed. The first one consists of large diameter wheels mounted in a nipple to be run above and below a bailer or pressure bomb. Although the wheels helped, line friction is such an important factor that no additional depth or angle of hole could be achieved to the stopping point. Two other devices, an electric motor driven

Continued on Page 252

NATIONAL SOLVES ANOTHER PROBLEM

CONDITIONS

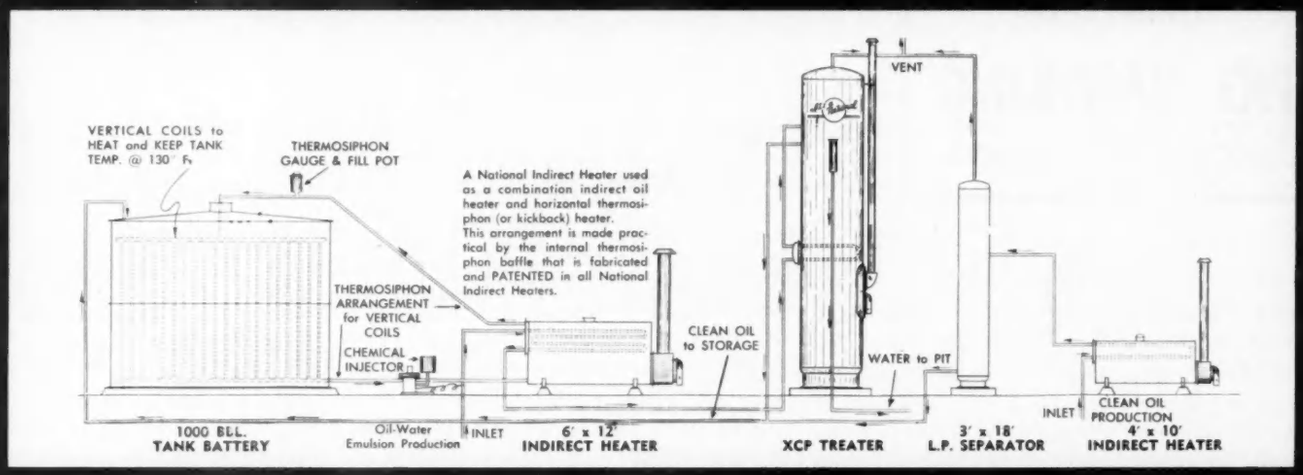
18° API Gravity, Asphalt Base Foaming Oil Production
One Well Producing no emulsion
One Well Producing 20% cut emulsion
Low GOR, Approx. 200 to 1
High Temperature pour point crude

REQUIREMENTS

De-gas Crude
Reduce Emulsion
Maintain storage temp. at approx. 130° so pipeline can pump oil out of storage.

SOLUTION

Use 4 x 10 Ind. Heater to preheat clean production for degassing.
Use 3 x 18 Separator to degas clean crude.
Use 6 x 12 Ind. Heater to preheat emulsion, AND to provide heat to the thermosiphon vertical coil system in storage tank.
Use XCP Treater to de-gas emulsion and dewater the crude.


VERTICAL COILS to HEAT and KEEP TANK TEMP. @ 130° F.
THERMOSIPHON GAUGE & FILL POT
A National Indirect Heater used as a combination indirect oil heater and horizontal thermosiphon (or kickback) heater. This arrangement is made practical by the internal thermosiphon baffle that is fabricated and PATENTED in all National Indirect Heaters.
THERMOSIPHON ARRANGEMENT for VERTICAL COILS
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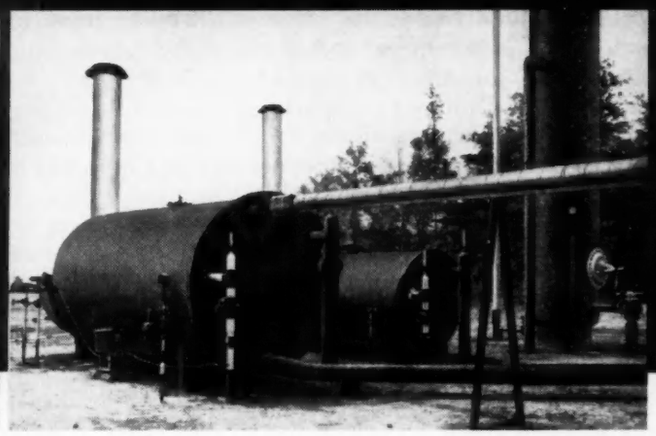
VENT
WATER to PIT
INLET
CLEAN OIL PRODUCTION
1000 BBL. TANK BATTERY
Oil-Water Emulsion Production
INLET
6' x 12' INDIRECT HEATER
XCP TREATER
3' x 18' L.P. SEPARATOR
4' x 10' INDIRECT HEATER



Good production is preheated in the small indirect heater then flows directly into insulated separator for degassing after heating. Emulsion crude flows through large indirect heater for preheating and chemical application then into preheating coil of National XCP Treater.

Unique in this hook-up is the method used to maintain 130 degrees temperature on the storage tanks. Each of the storage tanks contains a set of vertical coils that are used as heat exchangers. Hot water flows through these coils. The water is circulated thermosiphonically between the water bath of the large indirect heater and the coils in the tanks.

This entire arrangement is so complete that it requires very little of the pumper's time, thus, releasing him to other lease duties in addition to this lease. The treating problem on this lease represented a most difficult situation because the production was foaming and because the emulsion produced from these foaming wells was finely cut and because the viscosity of the oil was very high and because the storage tanks had to be maintained at such a high temperature.

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Safety Factors Involved In Drill Stem Testing

Drill stem testing, often regarded as strictly routine and trouble-free, actually requires planning and preparations to avoid blowouts, fires, and other rig disasters.

By ROY L. BULLS, Safety Director, Baker and Taylor Drilling Company, Amarillo

WHEN A DRILL STEM test is to be run, every man in the office and field hopes it will be run safely. This can usually be accomplished to everyone's satisfaction and protection if the people involved follow the recommended rules as set up by the Safety Committee of the American Association of Oilwell Drilling Contractors.

These are by no means all the rules necessary to the safety of personnel taking part in drill stem testing, but many more can be formulated by participants in each drill stem test. These recommendations cover a limited scope and are only general in subject. As application of each rule is made by the parties during the drill stem test, need for more detailed rules may be seen. It is suggested that a check-sheet be compiled, and as each item is accomplished let the person in charge of the drill stem test check that particular number off.

Definite assignments of duty for each member of the crew during the preliminary procedure involved before taking the test, eliminate duplications of actions and added expenditure of time in the beginning of the test. Above all, a thorough, concentrated job of applying the rules adopted should be made. Carelessness cannot make a safe test; alertness is a prerequisite to a safe operation.

1. The operators' representative in charge should hold an informal meeting prior to going in the hole. All persons participating in the test should be present to discuss such items as safety factors, exits and wind directions.

2. Mud should be checked for conditions to resist any possible blowout that might be encountered.

3. Fill-up lines will be installed on the drilling nipple above the blowout preventer to keep the casing full of mud, and should be used only for this purpose. Provisions for the kill line should be made separate.

4. Blowout preventer should be checked before going in the hole, as well as before coming out of the hole.

5. The cellar should be jetted or drained before starting the test.

6. All heating stoves and open fires are to be extinguished as a precautionary measure to prevent a fire hazard.

7. Be sure all ignition wiring is properly insulated on motor rigs.

8. On electric rigs, be sure blowers are operating properly and all generators are disconnected or shut down.

9. All steam rigs should have a steam line connected to the boiler firebox to snuff out the fire in case the well blows out.

10. Water connections to exhaust should be checked for proper spray.

11. Be certain all high pressure swings are snubbed or anchored down.

12. Mud guns should be installed in such a way that they can be used on the floor in case of fire.

13. All fire fighting equipment is to be inspected before starting the test.

14. Signs should be installed warning everyone to be cautious when entering the lease; all persons should leave tobacco, matches and lighters in the car or doghouse so as to prevent anyone from unconsciously creating a fire hazard.

15. One person should be designated to see that the casing is kept full at all times while going in the hole and coming out, and watch carefully for swabbing action.

16. Never take the rotary hose off to let the well flow through the kelly and out the goose neck.

17. No drill stem test should be conducted at night or during storms when excessive static electricity may be present.

18. In turning drill pipe by tongs to open tool, under no circumstances should more than one tong be used. If more power is needed, use a long handled wrench.

19. The derrick man should check his safety slide, line and exit for operation and accessability.

20. Drill stem safety plugs should always be used when pulling oil or gas loaded strings.

21. Mud box should be rigged with a flexible hose for safe discharge of fluid to the pits.

22. Regulate the valves on the surface manifold and attach the mani-

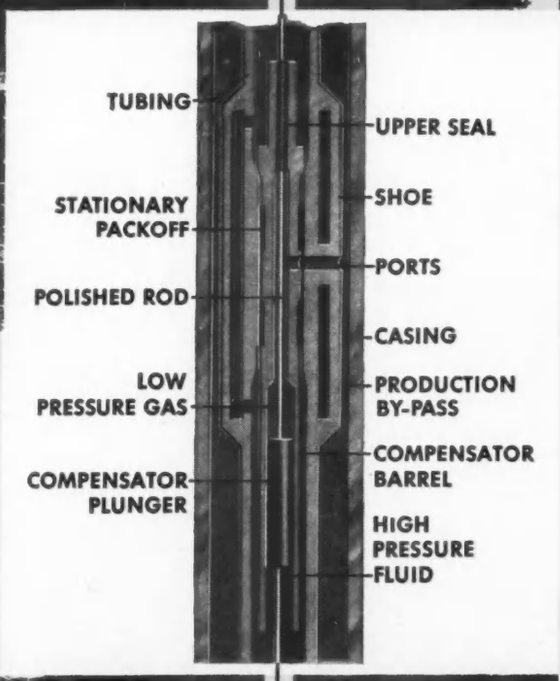
Continued on Page 220

SOMETHING FOR NOTHING

sounds mighty appealing, but like "lifting yourself by your bootstraps," it is in violation of the basic laws of science. Therefore, when we first told oil men how much weight reduction could be expected from a Rod Weight Compensator, they were skeptical and started calling the Compensator "Operation Bootstrap." That was when "Bootstrap Joe" came into being and we like to think of him as symbolic of the mighty upward thrust delivered midway down the rod string by the application of the hydrostatic pressure on the Compensator plunger.

But now the story has changed. Operators have witnessed installation after installation where the dead weight of the sucker rod string has been reduced by 33%. Now they are telling us it isn't "Operation Bootstrap" at all — that a Compensator is actually a two stage counterbalance with part of the rod load balanced out half way down the well. Others tell us we have placed an upside down pump in the middle of the rod string, and the lower pump only moves the fluid to the Compensator on the upstroke, while the Compensator boosts it to the surface on the downstroke.

We still like to believe in "Bootstrap Joe," but we don't argue. We do know that an Oilmaster Rod Weight Compensator permits more oil to be produced from greater depths than any other known means of sucker rod pumping. If deep well pumping is your problem, we suggest you get in touch with your Oilmaster Representative for further details on the...



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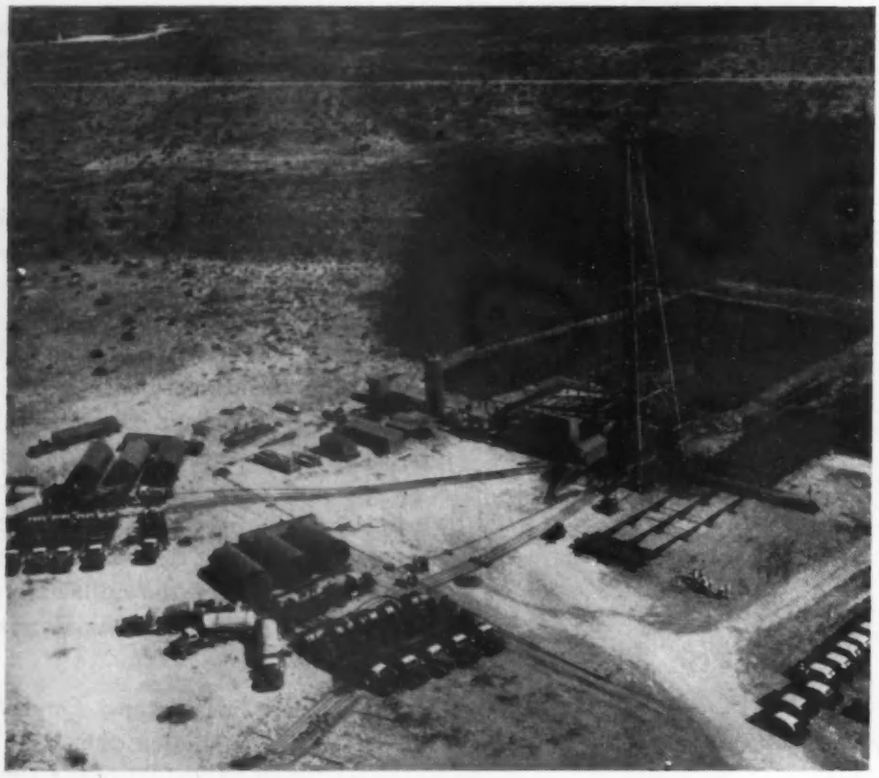


Open hole fracturing of the Headlee field Devonian formation results in . . .

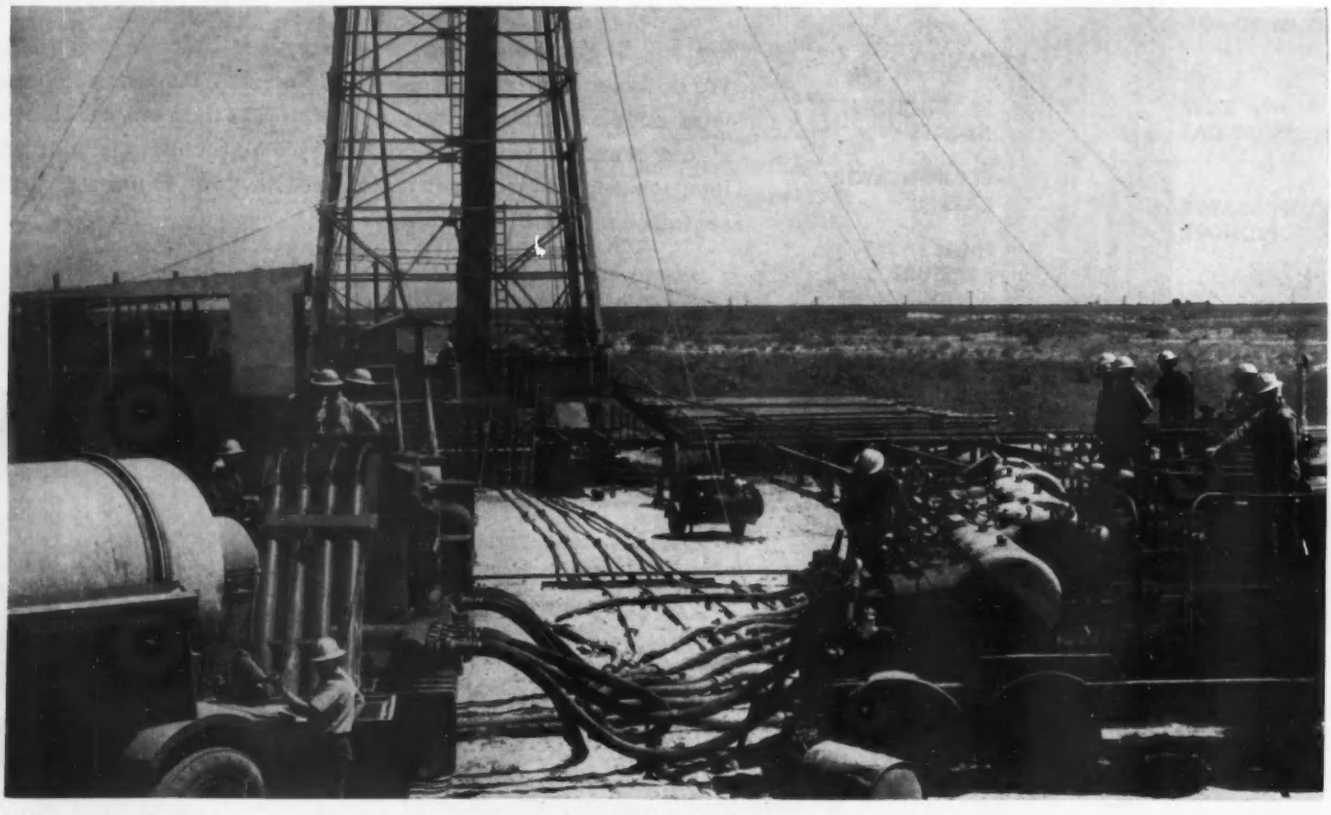
Texas' Biggest Fracturing Job

By ANTHONY GIBBON
WORLD OIL Staff

FRACTURING JOBS are getting bigger and better. Larger quantities of frac-material, bigger and more equipment with greater injection rates and pressures are becoming the rule. Recently one of the largest fracturing treatments was successfully completed in the Headlee Field, four miles East of Odessa, Texas, on Tidewater Association's Tom McKnight 5. Rated as a 150-barrel per day well the McKnight 5 flowed 588 barrels per day after treatment.

Tidewater's production men's decision to fracture the Devonian was based on the assumption that the Devonian could best be opened by a big fracturing job that would increase the slight incipient fractures, occurring naturally, and thus increase the formations permeability and flow capacity. Operators decided to treat the 110 feet of open hole at the bottom of the 12,000 foot well because more formation surface would be exposed by fracturing into open hole instead of through perforations.

The tight Devonian formation was



Massive equipment, working in perfect coordination, successfully completed Texas' largest fracturing job in the Permian Basin without a hitch. In foreground are bulk sand carriers and oil proportioners.

Step up your production operations with PAGE*

Sucker rod ON and OFF attachment

1 *RUN IN YOUR PUMP ON THE TUBING*

2 *EASY RELEASE IN CASE OF SANDED-UP PUMP*

3 *FISH BROKEN RODS WITHOUT PULLING PUMP*

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To operate, run the pump in on the tubing with the lower end of the PAGE tool in place. Then lower the rods with the matching ends of the tool attached. When the two sections of the ON AND OFF ATTACHMENT meet, turn right and lower to engage. Then a turn to the left will lock the two sections together.

To disconnect, lower the rods, turn right to the radial stop and pick up.

By means of this tool you can run pumps larger than the size of the tubing. Also broken sucker rods can be "fished" without unseating the pump or dumping the fluid.

The tool is rugged and simple in design—no complicated mechanism to offer trouble. Both the spear and socket sections of this PAGE ON AND OFF TOOL are milled with nine extra-heavy lugs to support the load and to assure long life.

Made for all sizes of sucker rods.

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PAGE TENSION TOOLS

fractured with 75,000 gallons of oil mixed with 1 pound of sand per gallon and established a number of firsts for the Permian Basin in so doing:

1. This job was the biggest fracturing job in Texas, the Permian Basin, and the Mid-Continent Area at the time.

2. Fracturing equipment at the location represented more total horsepower (7200) than on any previous fracturing job. (Figure 1.)

3. This was the deepest well thus treated through casing.

4. This was the deepest well for which a high injection rate was employed.

Equipment at the well included 12 fracturing trailers, each equipped with 2 heavy-duty pumps powered by a 300-horsepower diesel engine; pressurized and proportioning trucks (see Figure 2); 4 bulk sand trucks and 6 500-barrel field storage tanks. Special equipment such as a 12-opening fracturing head and large pressure gage (Figure 3) designed for the job had been procured and tested beforehand. This is believed to be the heaviest concentration of equipment ever assembled for a non-emergency job.

Before the job began a step-by-step outline of the job and each man's duties and responsibilities were discussed on the location. Safety instructions were given in detail to all persons connected with the job.

The job was started at 9:50 A.M. and completed at 11:19 A.M. The formation was broken down with 5000 gallons of treating oil, followed by 10,000 gallons of oil and sand, flushed with 6000 gallons of treating oil and followed by 65,000 gallons of oil with one pound of sand mixed per gallon. The 75,000 gallons of oil and sand entered the formation at an average pressure of 4800 pounds per square inch and at a rate of 26.5 barrels per minute. Only 8 of the 12 fracturing trailers were used during most of the job.

Initially rated as a 150 barrel per day well before treatment, the Tom McKnight 5 recorded an initial potential after treatment of 588 barrels per day of 42.6 degree gravity oil flowing through a 14/64-inch choke.

—The End

Safety Factors

Continued from Page 216

fold to the last joint in the running-in string while it is in the V-door or mousehole.

23. Do not attach choke or manifold assemblies at the end of the flow hose for floor connections.

24. If it becomes necessary to do any work above the floor, a stabbing board should be erected.

In the consideration of drill stem testing from the standpoint of safety, it is not the test itself that is dangerous to the personnel and equipment, but it is the trip out of the hole after the test is completed that the risk of fire and blowout is the greatest. Many times the personnel and supervisors have an inclination to relax after the tool has been opened. The knowledge of the contents of the formations being tested acts as a sedative to participants, so that their awareness of impending danger is considerably lessened.

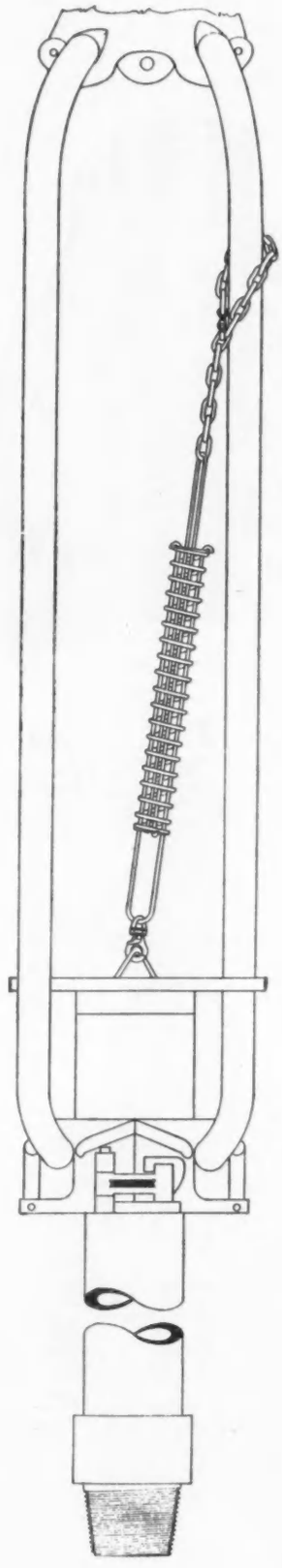
It is at this time, more than at any other, that caution should prevail, especially when the recovery indicates the presence of oil and gas. Too much emphasis cannot be placed on the dangers existing during the latter part of the drill stem test.

The use of safety plugs on the trip out is most important, although they are difficult to handle and are time-consuming. Present day plugs are usually made from tool joint pins and are rotated out of each stand. They prevent the discharge of gas and oil from the drill pipe as the stand is being elevated.

Much work is being done on the improvement of the safety plug which will be more effective and easier to handle. These last two factors should prove to be an incentive to the contractors and operators to use the newer type plugs.

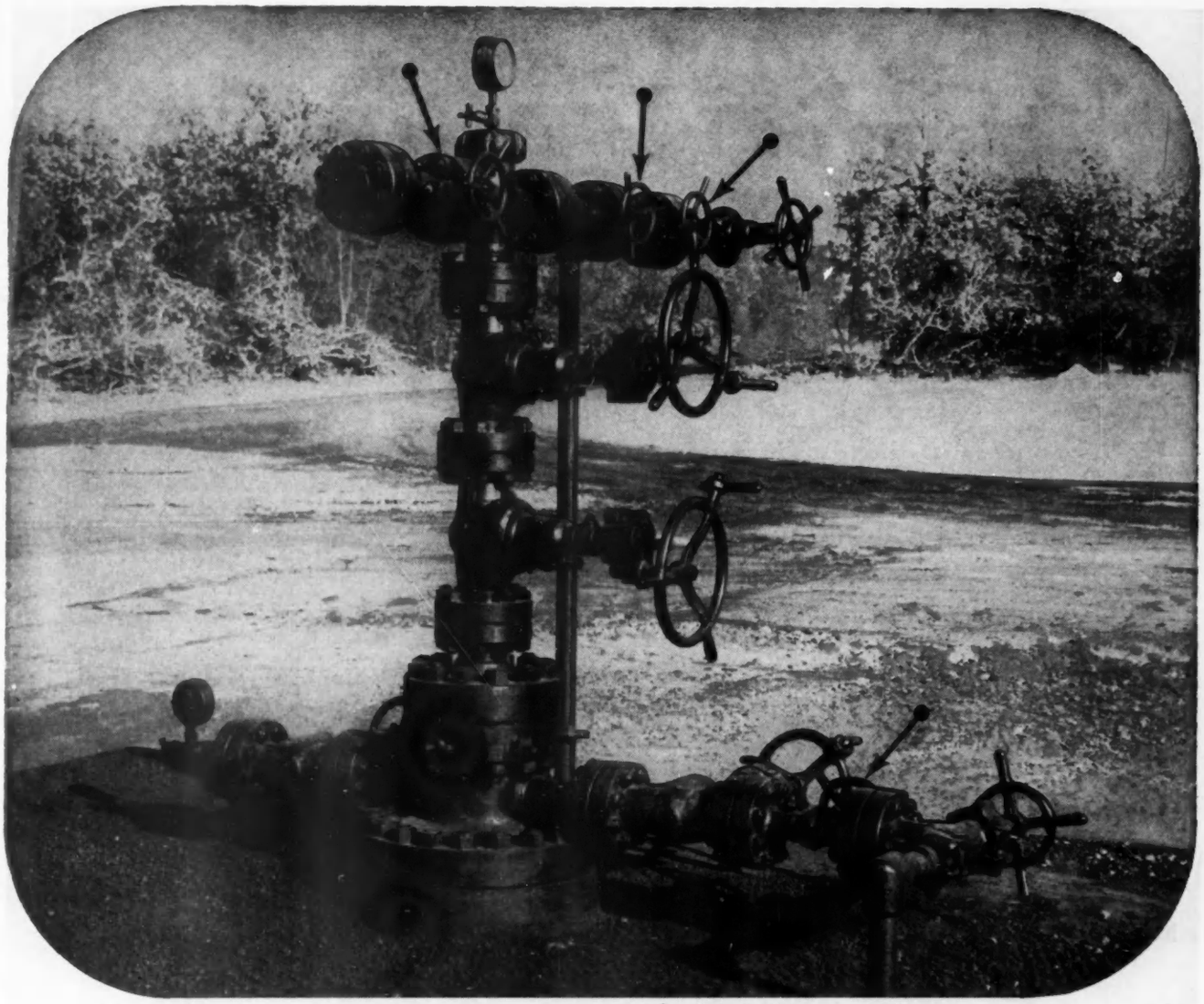
It is believed that with a more adequate safety plug being developed and more attention being called to the various dangerous aspects of drill stem testing, that soon this operation will become one of the safer performances in oil well drilling. Only the supervisors and personnel taking the drill stem test can really make it safe, and with vigilance and teamwork this can be done.

—The End



DRILL PIPE SAFETY PLUG

Though time consuming and difficult to handle, the use of safety plugs on the trip out is most important.



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Problems of Two-Zone Pumping And How They're Being Solved

Much progress has been made in pumping dual-zone wells. Present day methods have advanced to such a degree that economics require another appraisal be made of two-zone production.

Many Improvements in design, better completion practices, proper selection and operation of equipment have proven pumping to be a practical and economical means of operating dual wells.

New Equipment now gives operators a wide choice, making it possible to design installations which will fit practically all operating conditions likely to be encountered.

Proper Selection of equipment becomes highly important under these circumstances. Therefore, knowledge of available equipment and how it may be used becomes essential.

By BOB ERSKINE, Emsco Manufacturing Company, Garland, Texas

SUBSTANTIAL ECONOMICS are obtained in many areas by depleting two formations simultaneously within the same well bore. The saving in initial investment of drilling and equipping a dual well is forcibly evident over the costs of drilling twin wells.

Present day methods for the practicable and profitable production of dually completed wells progressed to such a degree that as a matter of practical economics operators are virtually compelled to review the possible advantages of two zone production before starting additional drilling and work-over programs.

It is often economically feasible to recomplete a single completion by coming up the hole or by deepening the well to complete in another zone. Often a maraginal zone, not economical to produce singly, may be produced in a dual well with substantial profits.

Artificial lift equipment for production of two zones simultaneously in the same well bore with the fluids separated at all times was developed in 1947. Some dual wells may flow for prolonged periods of time. Others may have zones that will only flow for short periods. Requiring the operator to resort to artificial lift for one or both zones. The development of the equipment was primarily for three purposes: First, to enable the operator to flow both zones; second, to flow one and pump the other; and third, to pump both zones.

Structure. Presently there are various methods of artificial lift as applied to dual completions. Dual gas lift systems, dual hydraulic pumps and rod type dual pumps are used. These rod type pumps may be classified into two main categories, the intermittent and the simultaneous types.

In the intermittent type only one zone is produced at a time and the monthly allowable must be obtained in a 15-day period. Production equipment appears in various forms. There is the movable tubing intake which may be accomplished by either rotating the tubing or by raising and lowering the tubing. This is performed by certain mechanisms at the well head which open and close certain intake ports in the tubing string at the point of the production packer. There also is the movable pump seat which is accomplished by raising and lowering the sucker rod string.

With the second class of rod type dual pumps, the simultaneous type, both formations are produced at the same time and fluids are kept separated at all times. This class also appears in various forms. It includes the parallel tubing string type in which two strings of tubing and rods are run in the same well bore and two surface pumping units are used. These two pumps work independently of each other. Another type of simultaneous dual rod pump employs a hollow sucker rod string. The upper zone fluid is conducted to the surface in these hollow rods; the lower zone fluid

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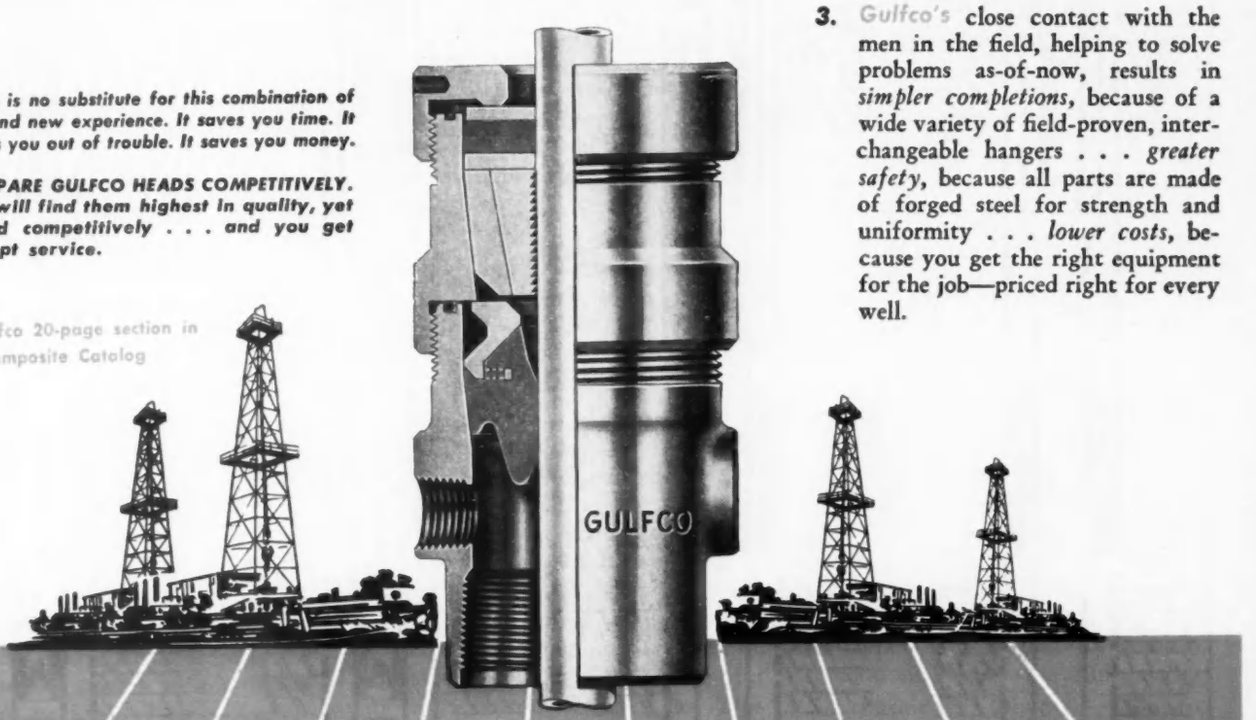

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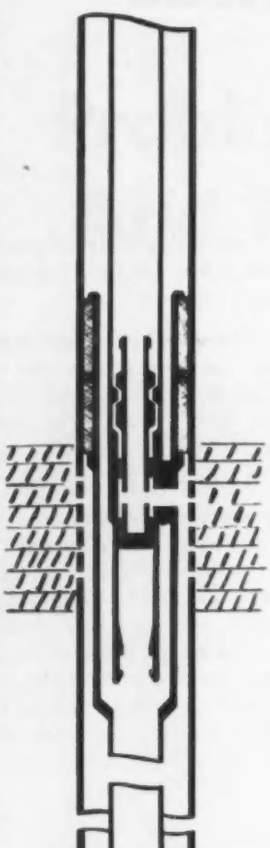
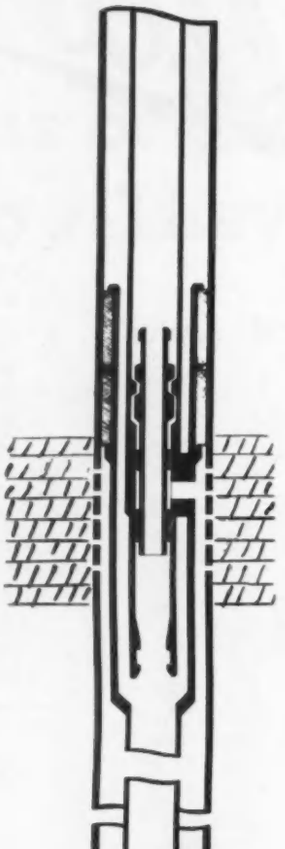
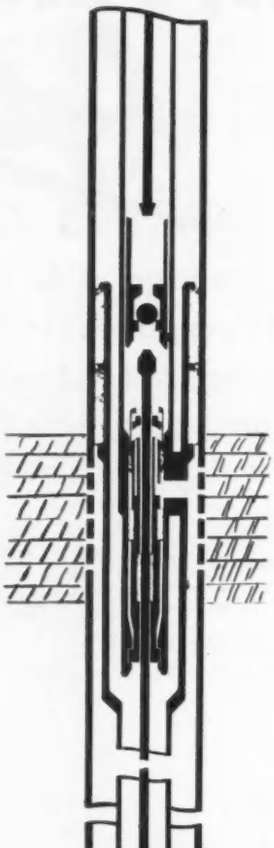


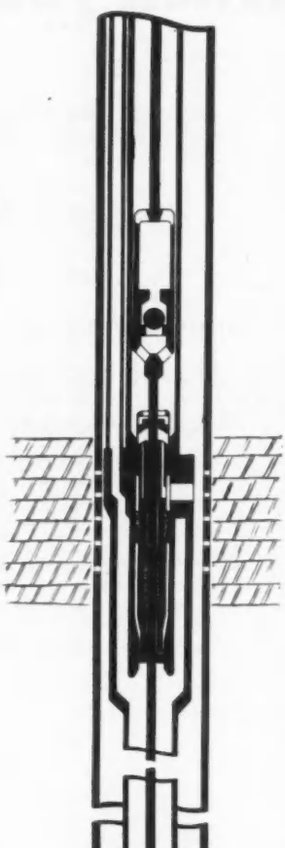
1. Schematic diagram showing use of removable cross-over choke installed in the upper annular packer. This enables the operator to flow the lower zone through the tubing casing annulus and the upper zone through the tubing. Certain completion and remedial operations may be performed through this equipment.



2. Schematic diagram showing removable straight through choke installed in upper annular packer. This equipment enables the operator to produce the lower zone through the tubing string. The upper zone is contained outside the tubing string and trapped between the two packers. Certain completion and remedial operations may be performed through this equipment.



3. Schematic diagram showing conventional type dual pump including two packers and the two pumps. The lower zone fluid is produced in the tubing casing annulus above the top annular packer and the upper zone fluid is produced in the tubing string.



4. Schematic diagram showing dual pump with parallel tubing strings. This equipment eliminates the use of the upper annular packer. Therefore, the gas from the upper zone may be vented through the annulus. The lower zone fluid is produced through the small parallel tubing string and the upper zone fluid is produced through the main tubing string.

is pumped in the tubing string around the hollow rods.

The dual lift equipment used most —is the single, solid, API sucker rod type. Of the various makes on the market, they generally consist of four main assemblies. First is the upper pump, which produces the upper zone fluid. Second is the annular packer and cross-over assembly, placed above the perforations of the upper zone, which crosses the lower zone fluid from the tubing to the casing and the upper zone fluid from the casing to the tubing. Third is the polished rod and sealing section. This is attached immediately below the upper pump plunger and is used to separate the two fluids on the sucker rod string and the internal bore of the cross-over assembly. Fourth is the lower pump which produces the fluid from the lower zone.

Another necessary piece of equipment is the production packer, but it is not included as an integral part of a dual pump as it is necessary in any multi-zone completion. Most production packers presently used in dual flowing oil wells may be utilized for dual pumping. However, these packers should include the following features: Very little or no tubing weight to obtain an effective seal; an internal bore no smaller than that of the tubing string; and ample slip area to eliminate the possibility of distorting the casing.

The lower zone fluid is pumped through the tubing string from below the production packer to a point at the annular packer and cross-over assembly. Here the lower zone is diverted into the tubing-casing annulus by virtue of the sealing section of the polished rod and the internal bore of the cross-over. The upper zone fluid is accepted into the cross-over and is pumped through the tubing string to the surface.

Dual well completion problems. It is important when planning dual artificial lift installations that a few of the generally accepted well completion practices be observed. This is of prime importance because if the well is being serviced, perhaps because of poor completion practice, the operator actually is losing production from two wells. When the lower zone is completed it is important that an accurate test be made to determine that separation has been obtained in the cementing operation. Also, accurate production requirements as to amount and type of fluid that must be produced should be obtained. It is also possible to test the retainer type production packers at this stage. After the upper zone has been perforated an accurate test should be taken for the amount and type of fluid to be produced.

It is important that the well be cleaned of any excess propping sand in the event fracture treatment has been used on either zone. If either zone has been acidized, the operator should make certain that the well is clean of any unspent acid. Junk-swab rubbers, packer elements, soft line, etc. should be removed by bailing or circulating.

Casing scrapers are recommended to remove burrs, mud or cement sheathes, which will aid in getting the packers down the hole in good condition and provide a clean surface for an effective seal.

After the well has been completed and tests have been made on both formations for production requirements and type of fluids, the proper type of equipment may be selected.

Equipment selection problems. If one or both of the formations will flow for a period of time, the operator should consider the proper sub-surface equipment which will enable him to produce this well as a flowing dual. When the need arises, he may use this same equipment to pump both zones. This is accomplished through use of a removable bottom hole choke. This same equipment enables the operator to perform certain completion and work-over operations through the tubing string on each zone on a selective basis.

Selective testing may be accomplished on each zone through the tubing string, as well as testing of both packers and tubing for leaks. All these operations may be performed without disturbing the tubing and packers once the tubing has been installed in the well, an important factor as added tubing jobs decrease the savings available in dual completions.

If the fluid from either, or both, zones is corrosive or abrasive, it is important that proper materials be utilized in the down hole equipment. Alloy metals may be used to combat corrosion, and hardened materials for abrasive conditions should be used.

Precautions should be taken in the event that fluids are of a paraffin base. Scrapers may be installed on the sucker rod string to remove paraffin in the tubing, and a circulating valve may be placed in the tubing string below the paraffin deposition level to circulate hot oil from tubing to casing. This will generally remove paraffin deposits in the annular space. This is important as difficulties may arise when pulling packers through paraffin deposits.

If the lower zone fluid which is normally in the tubing-casing annulus is highly corrosive, or if paraffin in the casing is a major problem, use of a parallel tubing string cross-over should be considered. The parallel string is used to conduct the lower zone fluid to the surface, protecting the casing wall from contamination by the lower zone fluid. Another important feature of this equipment is that the upper packer is eliminated and allows gas from the upper zone to be vented. Likewise, paraffin solvents and corrosion inhibitors may be introduced into the upper zone through the annular space.

A tubing drain should be considered in the installation below the cross-over assembly in the event that the upper pump becomes stuck in the tubing because of sand or detrital material. The drain may be hydraulically actuated releasing all fluid in the casing when the service job must be performed, eliminating swabbing the casing by the upper packer and its resulting tremendous load on the tubing string.

A means of supporting the top packer definitely should be considered. The differential pressure across this packer generally results in a downward thrust which will tend to buckle the tubing string between the two packers if the upper one is not anchored by some means. This will result in wear on sucker rods, couplings and tubing string.

An overload valve should be considered on the pump if a prolific formation is being produced. This spring-loaded traveling valve allows the specific pump to be taken out of service merely by closing a valve on the flowline at the surface.

A properly designed sucker rod string to effect maximum rigidity is an important factor to consider. The use of ⅝-inch sucker rods are not recommended even though there may be

ample strength in this size rod for existing loads. The larger size rod eliminates a certain amount of whipping and buckling on the downstroke of the pumps.

After the well has been completed and the equipment installed, the problem is to operate this equipment efficiently so that the over-all dual completion program will be an economical success.

Operation problems. When pumping oil wells under packers, which is a condition in dual wells, gas may be an aid or a hindrance. All formation gas must pass through the pump unless specific equipment has been selected to vent it, such as the parallel tubing string cross-over assembly. If the formation gas remains in solution until after it has passed through the pump, gas lock problems seldom occur. Generally, in this event when the gas is released from solution sufficient energy exists to cause the formation to head and flow. This can exist not only for the zone being produced in the tubing but also the zone in the tubing-casing annulus. A formation in a standard single completion that is being pumped without a tendency to flow will occasionaly head and flow once a packer has been installed. The pump will agitate the formation fluid to release sufficient gas energy to cause the same formation to flow through the tubing-casing annulus above the cross-over assembly.

When this heading and flowing occurs, several problems may exist. Uneven loading conditions on the surface equipment, for example the engine and unit, makes counterbalance on the pumping unit a problem. In the event of electrified leases, this results in excessive electric power useage. Repairs on multi-cylinder engines increase because of valve jobs, etc. Uneven loading will exist on the sucker rod string as well as surface equipment. Also, sub-surface pumps are affected when fluids flow through various parts at high velocities. Cages, balls and seats may be damaged by virtue of the ball traveling unevenly on all surfaces.

As gas is being released from solution, the cooling effect that results will allow paraffin to settle and deposit on the walls of the tubing and casing. If sufficient fluid energy exists, the formation may heave and allow sand to come into the well bore affecting operation of mechanical pumping equipment, as well as form sand bridges. One of the major problems due to wells heading and flowing is regulation of production and overloading tank battery facilities.

All the above type problems may be alleviated through use of a spring loaded pressure control valve on both the tubing and casing flowlines. This device holds adjustable back pressure at the well head and sub-surface pump. This additional back pressure makes the pump do the actual work and decreases the possibility of the well flowing.

If, however, gas proves to be a hindrance, in form of gas lock and low efficiencies, then the problem must be met by other methods. First the proper selection of pumps to handle gassy fluids is imperative. It is recommended that the plunger not have a traveling valve on top and double valve on the bottom. A single traveling valve on the bottom of the plunger as closely spaced to the standing valve as possible is recommended where severe gas conditions exist. Where only the one traveling valve is used, the best type of material for the ball and seat should be employed.

In two zone pumping, there are three friction loads on the mechanical system that affect plunger travel on the down stroke. These are the friction loads of the two plungers falling in their respective liner columns and the polished section of the sucker rod string falling into the sealing section. Because of this, travel of the plunger on the down stroke may be affected.

To improve the condition, the use of 1¼-inch polished rod material as sinker bars, or ⅞-inch sucker rods with slim hole couplings may be recommended betwen the two pumps as well as immediately above the upper pump. This additional rod weight not only improves and increases plunger travel, but also decreases amount of sucker rod whipping and buckling on the down stroke. This, of course, decreases the possibility of sucker rod pin and coupling failures.

If corrosion is a problem from either zone, proper selection of a cross-over device in order to use inhibitors below both pumps is an important factor to take into account. If paraffin is a problem from the lower zone, depositing in the tubing-casing annulus, use of hot oil to circulate and remove this paraffin must be considered. The periods of time to circulate this hot oil is dependent upon specific areas and formations. In southern Oklahoma, a month's period is used as the basis of circulating. Immediately before a service job, when the tubing is to be removed, hot oil should be circulated.

If production from the lower zone is relatively small, the amount of time to fill the tubing-casing annulus may amount to several days, especially in large casing sizes. Because of this, total fluid load on the sucker rod string may not be present until several days after the initial installation. It is sometimes important that the spacing of the pump immediately after installation be as close as possible. When total fluid load is placed on the rod string it possibly will be necessary to re-space the pump by raising the rod string a few inches after all the stretch has been placed in the rods. This will increase efficiencies of both pumps due to the closer available valve spacing.

During initial installation of equipment and subsequent service jobs, it is important that the tubing, rods and pumping equipment be kept as free as possible from sand and other foreign matter. Standing the tubing and hanging rods in a derrick help. If blowing sand prevails during the service operation, a steam truck should be used to clean foreign material from the tubing and rods.

During initial installations and subsequent service jobs, it is important that correct tallies be made of the tubing and sucker rod string so that all sub-surface equipment is properly placed in the well. Exacting well records should be kept on each installation, indicating where perforations for each zone occur, size and weight of casing, size and type of sub-surface equipment and its exact location in the well. The record also should include an exact tally of tubing and rod string between the two pump seats.

Dual pumps are operating in most areas of the U. S., Canada and South America and have proven to be a practical and economical means of artificial lifting oil. Through the many improvements in design, better completion practices, proper selection and operation of equipment, the acceptance of dual pumps in the oil producing industry will grow.

ACKNOWLEDGMENT

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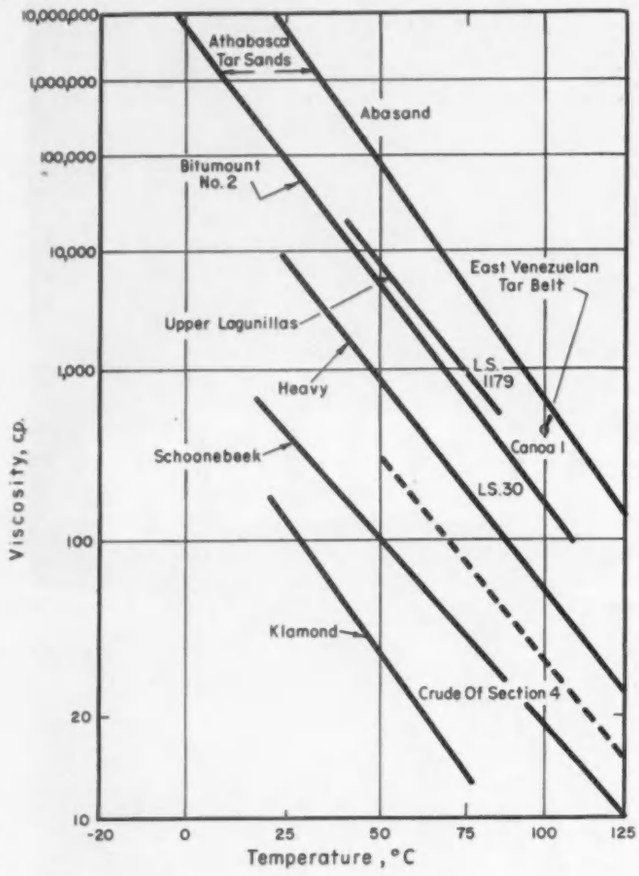

FIGURE 1 (left)—Tank oil viscosities of heavy crudes.

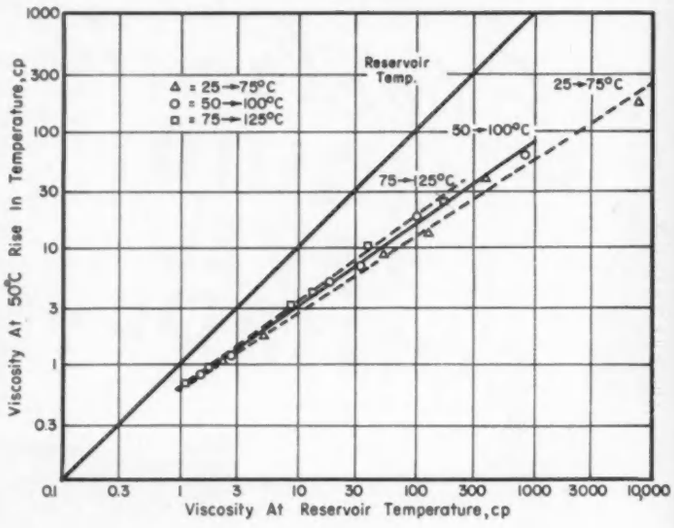

FIGURE 2 (above)—Crude viscosities at different temperature levels.

Recovery Increase by Thermal Drive

- What are the present aspects of increasing recovery by thermal drive?
- How do the reservoir production traits enter picture?
- What heating techniques are best suited for the methods?

By J. VAN HEININGEN and N. SCHWARZ

Koninklijke/Shell Laboratorium, Amsterdam

THE ULTIMATE recovery of most oil fields is low and amounts to only about 20-50 percent of the oil in place. Although there are fields where, under very favorable conditions, up to 80 percent of the oil may be produced, recoveries of 10-20 percent are very common, especially when viscosity of the oil is high. Many methods have been devised to increase these figures, but for viscous oils the current recovery practices unfortunately fail.

An improvement may be expected from a lowering of viscosity and it is obvious that this can be achieved by heating the reservoir.

Influence of production characteristics. The recoveries to be obtained from reservoirs differing in production characteristics will be compared at two different reservoir temperatures. The result will be a first estimate of the amount of extra oil to be recovered by uniform heating. The estimate will make it possible to derive general rules by which reservoirs and crudes may be classified as far as suitability for application of heating methods is concerned. It will be shown that some types of reservoirs and crudes can be discarded at once, whereas others will appear to offer certain possibilities.

The evaluation will be based essentially on relations between recovery and oil viscosity n, the latter being the main reservoir property affected by the rise in temperature. Therefore it is necessary for our evaluation to have an idea of temperature variation of crude oil viscosities. The viscosities

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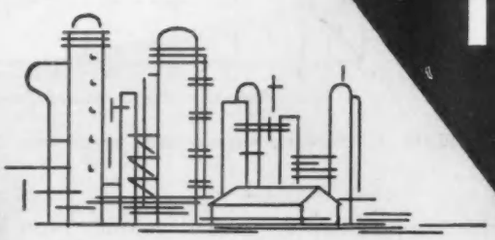

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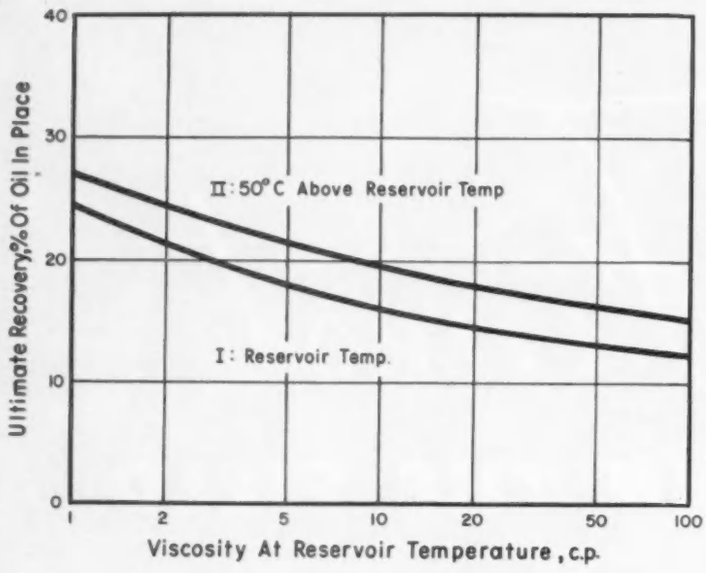

FIGURE 3—Increase in solution gas drive recovery by uniform heating.

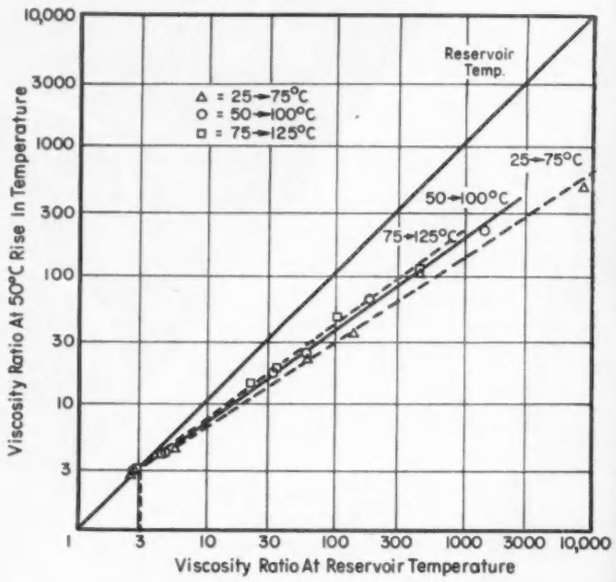

FIGURE 4—Oil/water viscosity ratio at different temperature levels.

of various heavy crudes have been plotted versus temperature in Figure 1.

The viscosities plotted are tank oil viscosities; the viscosities of reservoir crudes will be a factor of 1-4 lower, but dependence on temperature is thought to be typical enough to serve our purpose.

In the following we will consider a rise in temperature of 50° C.

The decrease in n caused by this temperature rise is illustrated in Figure 2 where the viscosity at 50° C. above reservoir temperature is plotted against viscosity at reservoir temperature. The circles refer to a reservoir temperature of 50° C. and are obtained by plotting n100 for the various crudes of Figure 1 against n50 for the same crudes. The line drawn at an angle of 45° C. and marked "reservoir temperature" represents n at reservoir temperature, and thus the difference in ordinate between that line and the line "50° C.—100° C." gives viscosity decrease.

The same procedure has been followed for reservoir temperatures of 25° C. (the triangles and the dotted line marked "25° C.—75° C.") and of 75° C. (the squares and dotted line marked "75° C.—125° C."). From these lines it may be concluded that the effect of a 50° C. rise in temperature on viscosity of a crude of a given viscosity at reservoir temperature is greater, the lower the reservoir temperature. The dotted lines, however, deviate only slightly from the "50° C.—100° C." line, and thus influence of reservoir temperature is small.

The effect of oil viscosity on recovery will now be evaluated. It will be useful to take solution gas drive fields and water-drive fields as extremes. A gas cap drive can be expected to be an intermediate case.

For solution gas drive fields Muskat[1] has calculated the recovery of reservoir oil, expressed as a percentage of original oil in place, as a function of n. His results are replotted in Figure 3, Curve I. Assuming a reservoir temperature of 50° C., this curve has been combined with the line "50° C.—100° C." of Figure 2, so as to give Curve II of Figure 3, which indicates the recovery at 100° C. as a function of original reservoir oil viscosity.

Muskat's data, as plotted in Figure 3, Curve I, relate to average natural solution gas/oil ratios. This implies that recoveries for a 50° C. rise in temperature, as given in Curve II, are optimistic, because amount of gas in solution will be smaller than Muskat's figure for the correpsonding viscosity.

The position of the two curves in Figure 3 leads to the following conclusion: A 50° C. increase in temperature of a solution gas drive reservoir results in a recovery increase of less than 3-3.5 percent of the oil in place, irrespective of the original reservoir oil viscosity.

For water-drive fields we must take into account the fact that the governing factor for recovery is the oil/water viscosity ratio M (vide Engelberts and Klinkenberg.[2])

Therefore, a relationship similar to that of Figure 2 has been plotted for the oil/water viscosity ratio M in Figure 4 for each of the crudes in question. The triangles and squares, through which the dotted lines are drawn, again refer to original reservoir temperatures of 25 and 75° C., respectively. The decrease in M for 50° C. increase in temperature (the difference in ordinate between the line "reservoir temperature" and the lines "25° C.—75° C.," "50° C.—100° C.," or "75° C.—125° C.") appears to be smaller than in the case of n (Figure 2), owing to the adverse effect of the decrease of n water with temperature.

For $M < 3$ heating even results in an increase of M. In addition, it will be seen that the influence of reservoir temperature (the deviation of the dotted from the solid lines) is again small, although relatively larger than in the case of n.

For an estimate of the recovery from water-drive fields we will use the results of model experiments carried out by Croes and Schwarz,[3] although these refer to linear drives only. The economic limit of the water cut is assumed to be 98 percent for production at reservoir temperature and 97 percent at 50° C. above reservoir temperature (lower, because of the higher costs).

In Figure 5 oil recovery at a water cut of 98 percent (curve I, reservoir temperature) is plotted against M as

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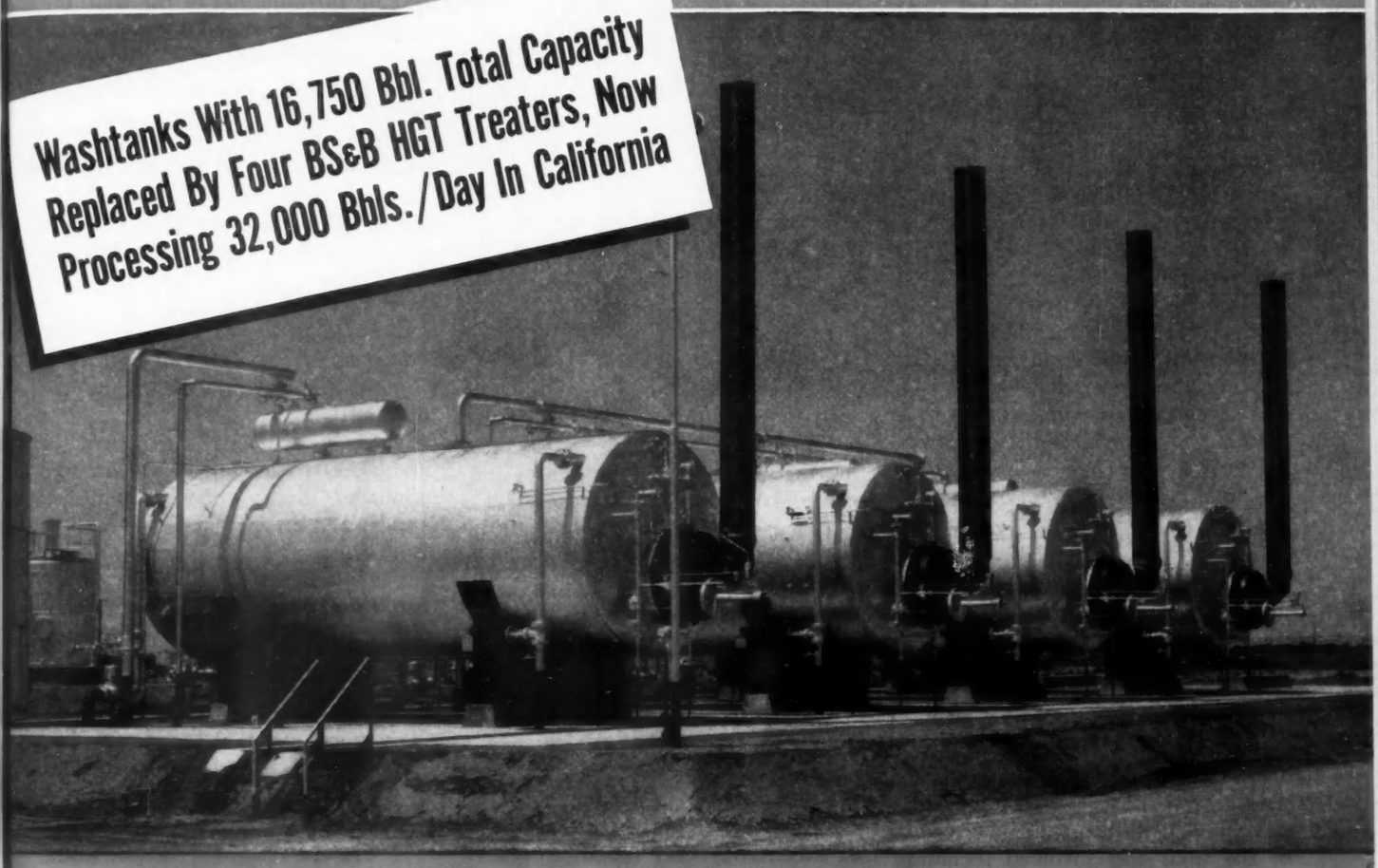

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derived from the diagram published by Croes and Schwarz. Again assuming an original reservoir temperature of 50° C., the viscosity ratio at 100° C. can be read from the 50° C.—100° C. line of Figure 4, and, applying the readings to the diagram mentioned for a 97 percent cut, Curve II (50° C. above reservoir temperature) of Figure 5 is found.

The increase in recovery due to heating easily can be read from this graph; for instance, the reservoir oil recovery from a water-drive reservoir with a viscosity ratio of 30 at a reservoir temperature of 50° C. can be increased from 68.5 percent to 71.5 percent of the original reservoir oil in place by homogeneous heating to 100° C. This is about the same increase as for the 30 cp oil of the solution gas drive reservoir, but it is a much smaller percentage of the conventional recovery since natural recoveries drop, whereas extra recovery due to heating increases.

A 50° C. increase in temperature of a water-drive reservoir results in a recovery increase which is greater, the higher the original oil/water viscosity ratio and which attains values of about 50 percent of the natural recovery for original oil/water viscosity ratios of 500.

The proper way of evaluating economics of heating methods is by comparing present-day value of the extra oil obtained with present-day value of the total cost involved including fuel consumption, installation costs, extra operation costs, royalties, etc. The results of such calculations will be affected by many local conditions, but the main item on the cost side always will be fuel.

As a general conclusion of this section we can state that solution gas drive fields offer no prospects for heating methods; water drive fields offer prospects, provided viscosity ratio is high enough.

Survey of possible heating methods. In considering heating of reservoirs it must be realized that considerable losses to surrounding formations cannot be avoided in spite of low thermal conductivity of rocks.

The energy required for heating an underground reservoir can be supplied in various forms. The following classification is based on the manner in which energy can reach a point in the reservoir.

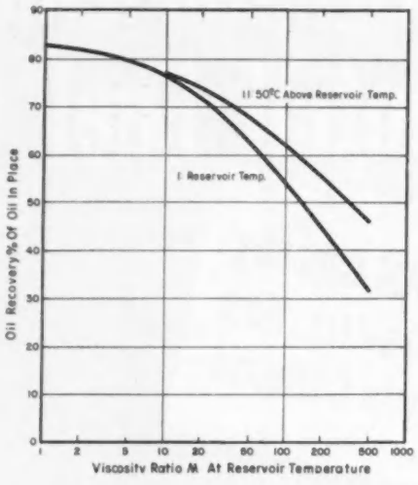

FIGURE 5—Increase in water drive recovery by uniform heating.

1. Heat transferred to the reservoir rock:

A. By convection: a hot fluid (steam, water, oil or gas) is injected into the well so that it penetrates into or circulates through the reservoir.

B. By conduction from a well, where it is generated by an electrical coil (Ljungström method of shale oil recovery,[4]) a steam coil,[5] or by combustion of gas or oil.

2. Mechanical energy: Sonic or ultrasonic waves. It technically is impossible to generate sonic or ultrasonic energy within a well in sufficient quantities. Therefore, this form of energy can be disregarded.

3. Electromagnetic radiation generated down the hole. The penetration power of electromagnetic radiation of short wave length in rock formations is very low: only 0.1 percent is transmitted by a layer of 1 mm thickness in the infrared range, so that after 1 mm, intensity of the wave has dropped to 0.1 percent of its value. Thus, a source of electromagnetic radiation in a well has the same effect as the heating coils of case 1B, since here also the energy is transported mainly by heat conduction.

4. Electrical energy can be supplied if resistivity of part of the reservoir rock is low, as is mostly the case in the waterbearing part of oil reservoirs with edge water. By placing electrodes in wells penetrating the water-filled formation near water-oil contact and passing alternating current through the edge water, the latter can be heated to any temperature below its boiling point. The edge water in turn heats the oil zone.[6]

5. Chemical energy. A combustion reaction seems to be the only possibility deserving consideration.

A. Fuel (oil or gas), together with oxygen (or air), is pumped into a well and ignited down the hole.[7,8] Since combustion is confined to immediate surroundings of the well, the case is very similar to 1A or 1B, depending on whether exhaust gas is injected into the formation or produced from the well.

B. The reservoir is filled with an explosive mixture of gas and oxygen (or air), which is ignited. An advantage of this method would be that the reservoir is heated instantaneously.

C. Oxygen (or air) is injected into a gas cap and ignited. The combustion of the gas cap in place may have some merits, but high-viscosity reservoirs with a gas cap of any importance are very rare.

D. Oxygen (or air), with or without gas, is injected into wells, and circulated through the reservoir.[9,10] Part of the oil in place is burned in situ and a combustion zone travels through the reservoir, pushing ahead distilled, cracked and visbroken products that in turn are produced through producing wells.

6. Nuclear energy: Letting down either an atomic pile or an atomic bomb into a well.

A. An atomic pile is just another means of heating a well, and hence this case is identical with 1B.

B. The use of atomic bombs would appear to involve considerable unknown risks.

From the above survey it appears that apart from the in-situ combustion method, injection of a hot fluid is the most attractive method.

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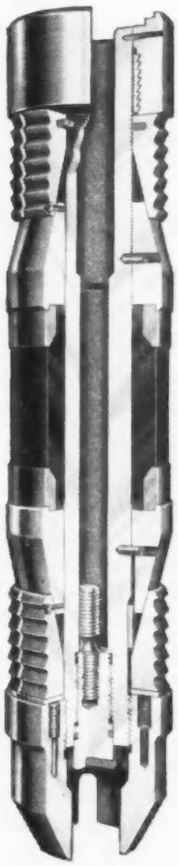

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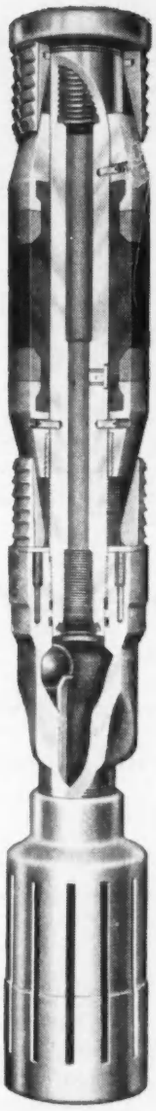

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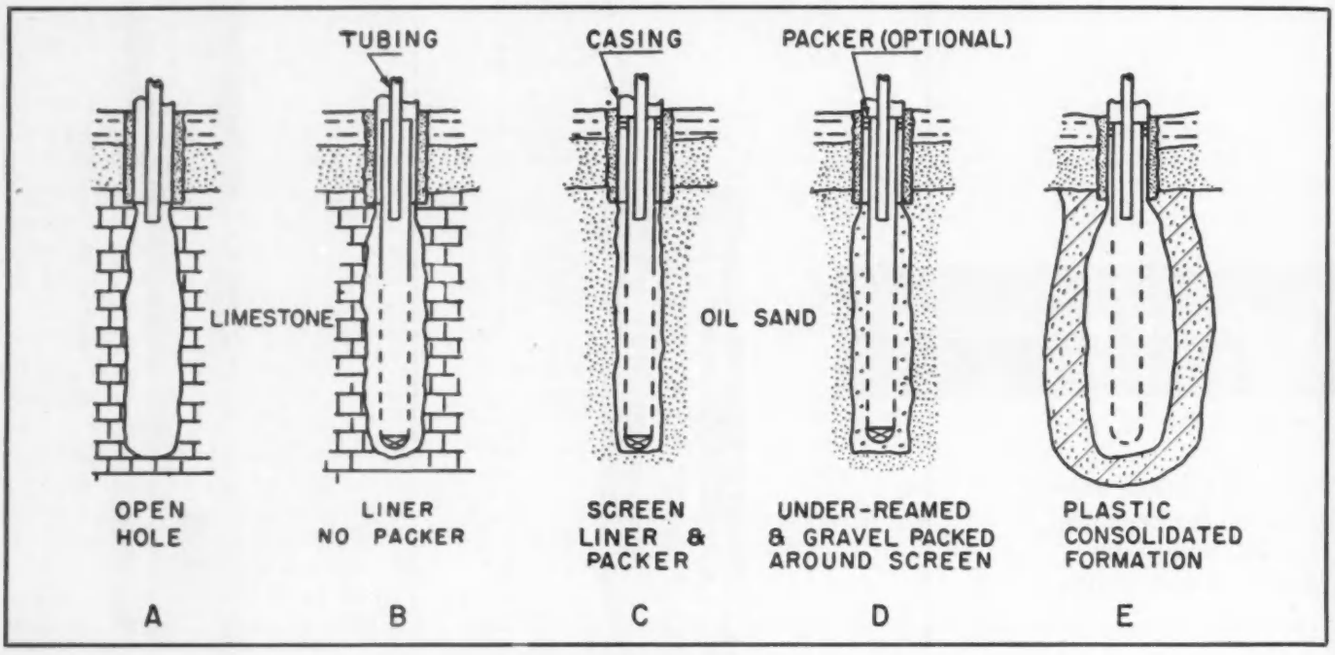


FIGURE 1—Open hole completions.

Modern Well Completion Methods: U. S. A.

Here is an up-to-date review of the various drilling-in techniques, the effects of drilling fluids, perforations and cements on permeability impairment, and modern well equipping and stimulation methods.

By A. S. SOLLIDAY, Executive Vice President,
Stanolind Oil and Gas Company, Tulsa

BECAUSE OF increasing technical knowledge, well completions are no longer a haphazard affair, but are designed from the mud program to the final nippling-up so as to obtain maximum production. Drilling-in fluids, methods of casing or lining, perforating, cementing, and production stimulation are all carefully considered in modern well completions.

The term "well completion" includes all operations required to place a well on production after the pay formation is encountered until all drilling, cementing and production stimulation operations are completed. As a result of experience, research, and development, well completion has become a refined technique resulting in a greater recovery of oil and gas in a more efficient manner.

DRILLING THE PAY

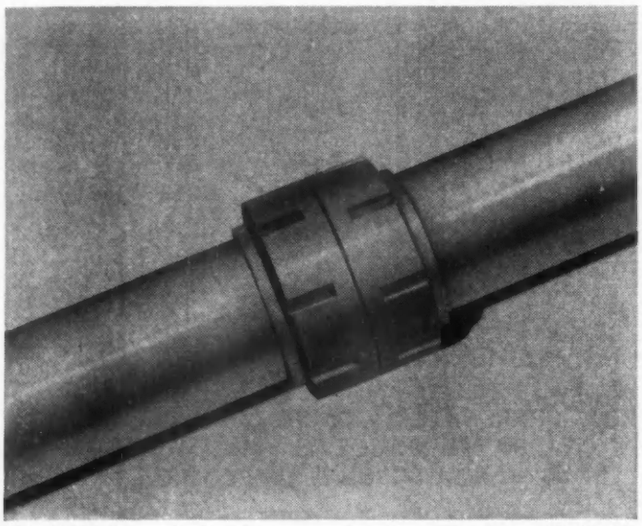
Drilling-In Fluids. In selecting the drilling fluid, consideration should be given to factors relating to effect on productivity: (a) ease of removal of mud and mud filter cake from the well, (b) peneration of the mud and mud filtrates into the pores, (c) reaction with clays present in the pay, and (d) formation of precipitates. There are now six prinicpal types of drilling fluids used in the U. S.

Water-base muds are widely used in rotary drilling. These muds are available in most areas, afford good pressure control, are not hazardous, are inexpensive, and require little rig time to prepare. Productivity impairment due to particle intrusion, clay swelling and water blocking of the producing formation is a limitation on their use. Also, accumulation of solids content adversely affects the viscosity-gel strength and characteristics of the mud.

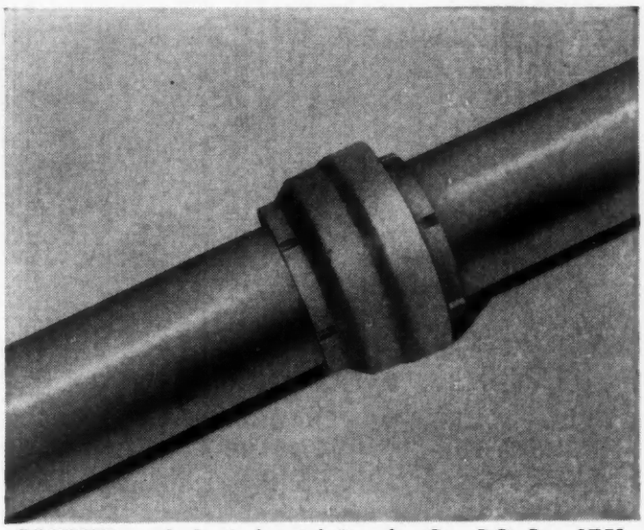
Oil-base muds afford good pressure control, provide good lubrication (less rotary torque), allow recovery of cores uncontaminated with drilling water, and eliminate productivity impairment due to clay hydration and water-blocking. This mud is expensive. The fire hazard, high cost, its objectionable handling characteristics, and limitations imposed on electric logging, have slowed acceptance of oil-base muds.

Emulsion muds are proving successful because of a wide variation in characteristics obtainable. Oil-in-water emulsion muds are water-base muds with 10 to 20 percent oil added. They exhibit the general characteristics of water-base muds; however, they provide a reduced filtrate loss, are better lubricants which result in faster drilling rates, and can be made lighter in weight. Water-in-oil emulsions, possess the general properties of oil-base muds, but are less expensive. Water-in-oil emulsions, have limitations similar to oil base muds.

Oil is available in most areas and



COUPLER made by Gateway Engineering Co., 3233 W. Grand Avenue, Chicago 51, Ill.



COUPLER made by Industrial Coupler Co., P.O. Box 1751, 4218 Boone Ave., Spokane, Wash.

num worked closely with these manufacturers in the design of the couplers.

They are all cast aluminum and require no welding. Instead, they are designed to engage the flared or flanged ends of the aluminum pipe sections with O-ring or molded type neoprene gaskets, seated in the coupler bodies by means of threaded locking nuts.

The locking nuts require only hand pressure with 6" spanner wrenches to guarantee leakproof connections at liquid or gas pressures from 0 to 1,000 psi.

The couplers provide highly flexible connections, permitting pipe to be laid around obstacles and over rough country without special equipment.

Flanging of the pipe can be accomplished either by power machinery in a shop or by hand tools in the field. This field flanging, plus the fact that no welding is required, permits quick and easy manifolding simply by cutting the tube to the desired length, slipping coupler over the tube, flaring the end and connecting.

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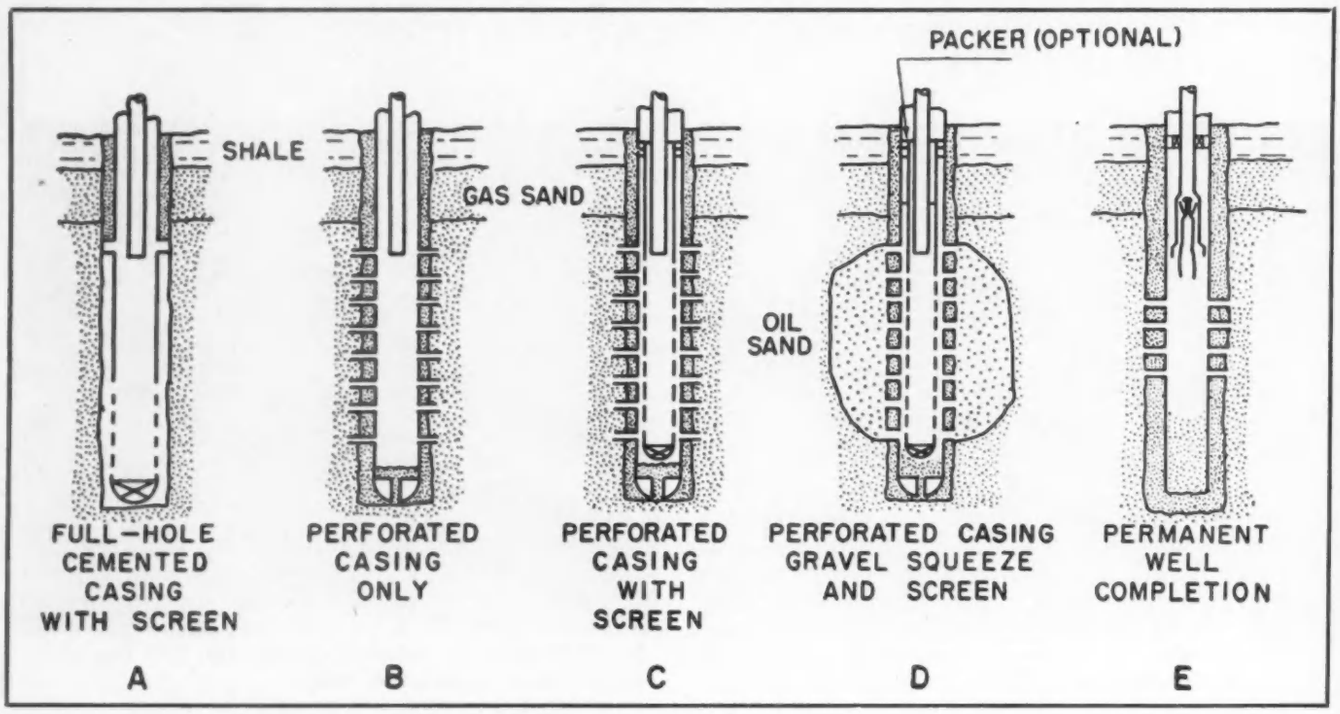

FIGURE 2—Cased hole completions.

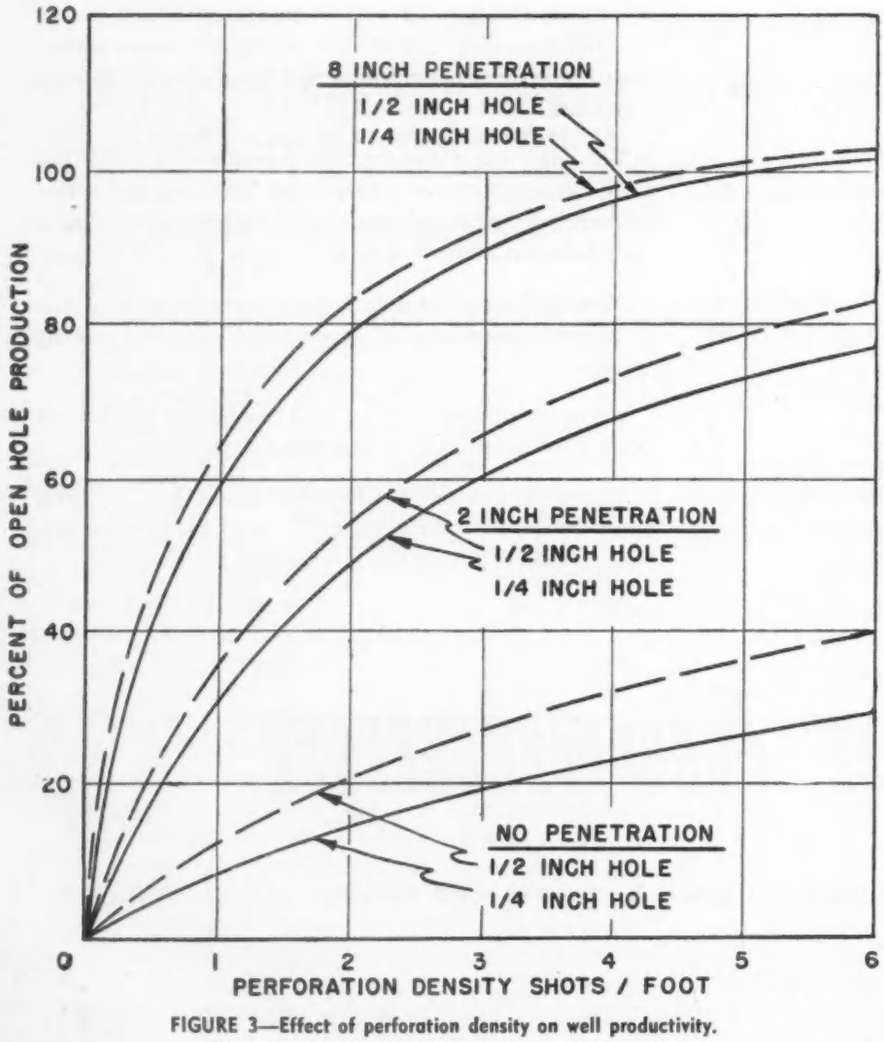

FIGURE 3—Effect of perforation density on well productivity.

is relatively inexpensive. It has found considerable application for drilling pay formations found to be seriously damaged by water. Increased drilling rates are often observed. Poor pressure control, fire hazard, and drilling crew opposition are limitations.

Fresh water and salt water are widely available and are inexpensive in most areas. Provided the solids content is maintained at a low level, water also has the advantage of faster drilling rates. Clay swelling, water blocking, shale sloughing, loss of circulation, and poor pressure control are major limitations on their use.

Air or gas is inexpensive as compared to other drilling fluids and extremely fast drilling rates are usually obtained. Experience has shown that these gases result in minimum productivity impairment. The presence of formation water usually prevents removal of the cuttings from the hole. Caution, however, is necessary to minimize fire, blowout, and explosion hazards. The fluid selected for drilling-in operations is very important as it affects drilling rates and productivity of the well.

Lost Circulation. All or part of the drilling mud that is used for rotary drilling may be lost to crevices or channels. If lost circulation occurs in nonproductive formations, permanent plugging of the openings is desirable. However, lost circulation, while drill-

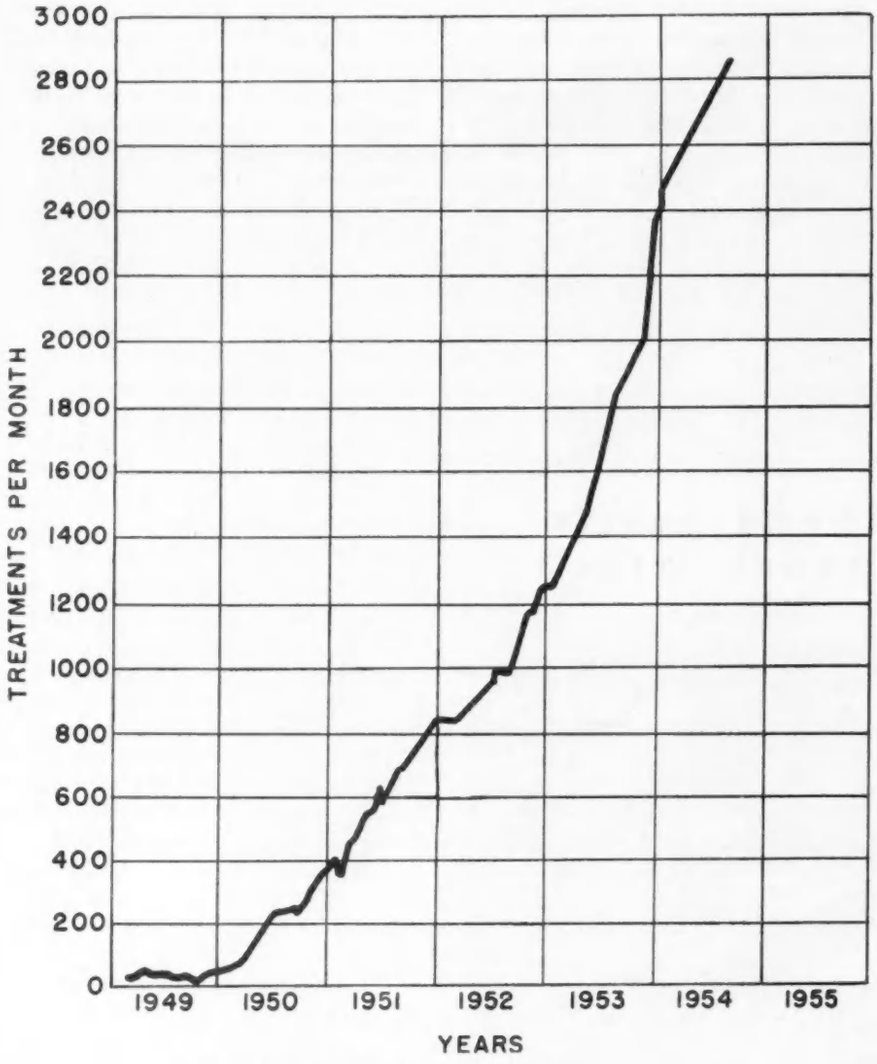

FIGURE 4—Growth of the hydraulic fracturing process.

ing the pay, results in high costs and difficult well control, and it may damage the producting formation. Remedial procedures employing granular, oil-soluble, plugging agents are now in use which permit the temporary plugging of porous zones within the pay without the hazard of permanent plugging.

Coring and Logging. Formation characteristics, as thy influence the choice of methods for completing wells, have placed added emphasis on obtaining good cores and well logs. Developments in radioactivity logging include the scintillation counter, the neutron-neutron logs, and radiactive isotopes for tracer logging. In electric logging, the introduction of the micro type and the focus logging devices have been proved useful, particularly in evaluating interbedded formations.

TYPE OF COMPLETION

The choice of method of completion depends almost entirely on the characteristics of the producing formation.

Open-Hole Completion. The open-hole completion employing no screen or liner to support the formation (Figure 1-A) is the most inexpensive and avoids permeability impairment by intrusion of cement slurry filtrate. These completions are generally restricted to formations where relatively, clean hole conditions will prevail during the normal producing life of the well. Massive zones of low permeability and porosity, and formations of such low vertical permeability that drainage through a cased hole requires a prohibitive number of perforations, are well suited to this type of completion. Such completions permit stimulation by hydraulic fracturing, acidizing, or shooting, without damage to the casing.

Loose sand in open hole can be controlled by screens, liners, liner-packer combination, gravel packing and plastic formation consolidation (Figure 1-E). The principle advances which have been made in gravel packing are better selection of proper gravel size and volume, and use of oil-base placement fluids.

The use of plastics for this purpose has been rather limited due to resultant excessive permeability reductions, high cost, and erratic setting characteristics as influenced by well conditions.

Cased-Hole Completion. Cased-hole completions generally are used in incompetent formations, multiple pay zones, or wells completed in close proximity to gas or water. Four principle methods of completing wells in these formations are currently practiced.

Full-hole cemented casing with screen (Figure 2-A) offers the advantage of completing the drilling operations prior to running casing; and the pay is not damaged from cement filtrate invasion. This method finds particular application in pay zones containing crevices or vugs where loss of cement is detrimental.

Perforated casing (Figure 2-B) is the most common type of cased-hole completion; running the casing through the producing formation, cementing the pipe in place, and perforating the desired zones. It has the advantages of maximum selectivity, adaptability to multiple zone completion, good gas and water control, and prevention of sloughing.

Perforated casing and screen combinations (Figure 2-C) are used in those formations that produce sand through the perforated pipe and thus foul or erode well equipment. Limitations are the cost of running the screen and problems incurred in performing future remedial operations.

Perforated casing, gravel pack, and screen combination (Figure 2-D) are also employed in incompetent formations to prevent the flow of sand into the well. This type involves running and cementing casing through the pay zone, perforating the casing, washing out a section of the formation behind the pipe and cement sheath, and displacing into this void a gravel barrier to support the incompetent formation. The gravel is retained against the formation by a liner or screen set opposite the perforated pipe. This method introduces some complications in selective com-

pletion of multiple zones, and it may increase the difficulties in controlling gas and water production.

Permanent-type completion (Figure 2-E) involves drilling the producing formation, setting and cementing casing, placing the tubing in the well, and removing the drilling unit prior to completing the well. All other completion operations are performed with wire line tools operating through the tubing. Advantages are that it affords an inexpensive method of completion and recompletion and keeps all undesirable well fluids off the formation after cementing the casing.

After completion method has been selected there are several auxiliary operations that may be performed to open up or stimulate production.

Perforating Casing. Two principal methods are used to perforate wells: (a) the shaped charge perforator gives maximum penetration, minimum cement damage, little burring, relatively small hole size, and is available in expendable guns, and (b) the bullet perforator has a slight cost advantage over the shaped charge, produces a larger, more uniform diameter hole, and can be selectively fired for better depth control. The primary disadvantage of bullet perforating is its short penetration and tendency to shatter the cement sheath.

Well productivity is a function of perforation density as shown in Figure 3. Under field conditions, densities as high as 6 or 8 perforations per foot have produced higher productivity than so indicated. This is believed the result of cracking or shattering of the formation with the greater perforation density.

Well productivity is also influenced by depth of penetration; the effect, however, being most pronounced within the first five inches beyond the cement sheath surrounding the casing. Presence of fluids in the hole while perforating and compaction of rock along the edge of the penetration have a tendency to restrict productivity.

Shooting. Explosives have been used for over 50 years to stimulate oil production by creating extensive, but local, fracturing around the well.

Dolomites and hard sandstones respond best to shooting; soft unconsolidated sandstones are sometimes harmed.

Three principal well-shooting techniques are employed:

1. A high concentration of explosive is placed in the interval to be treated and tamped into place to utilize the maximum energy in cracking the formation. It is now used frequently in stripper wells.

2. In a more recent development, the explosive charge is placed opposite the producing interval with no tamp. The objective is to sacrifice a portion of the explosive energy, as directed to fracturing, to partially clean out the well.

3. The third method is "squib" shooting, where a small amount of explosive is placed opposite the selected interval. This is often used where impairment to permeability in the well bore exists.

Well-shooting in many areas has been succeeded by hydraulic fracturing.

Acidizing. Limestone or dolomite reservoirs often lack adequate permeability, although they have sufficient porosity, for commercial development. Acid treatment is used to dissolve rock from the pore channels

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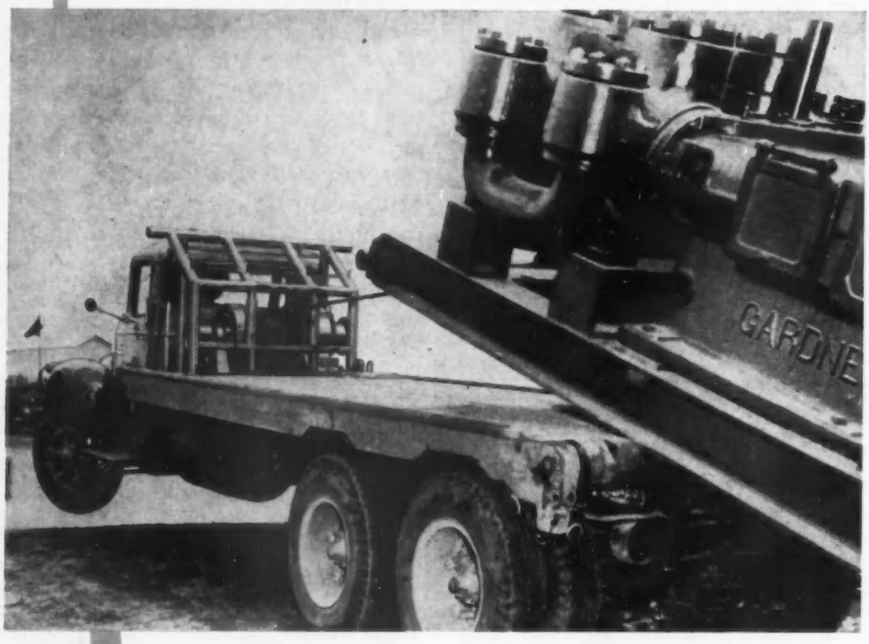

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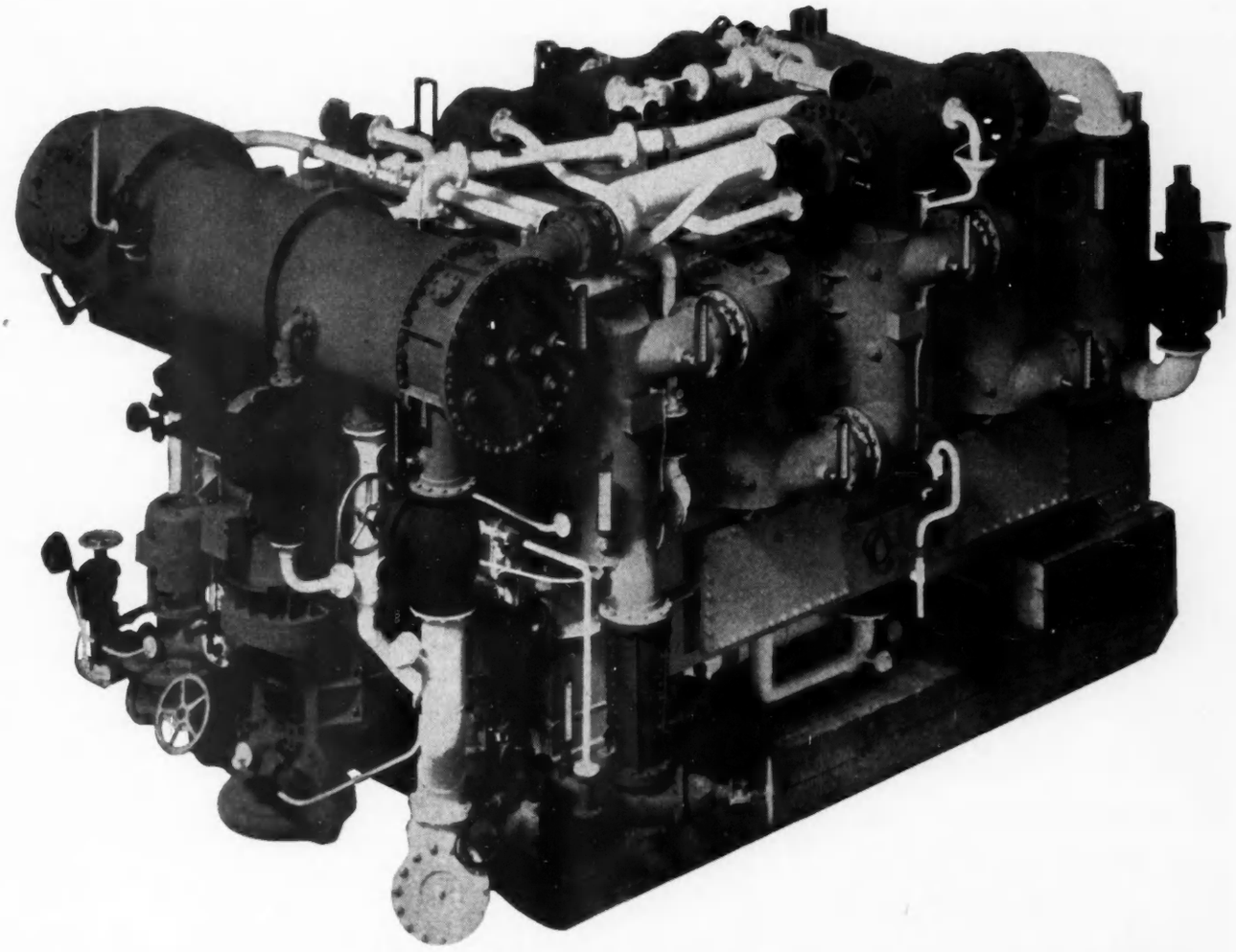

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thereby increasing their diameter and permeability.

The successful treatment must place the acid opposite the desired interval, displace it into the formation at a sufficient rate to insure maximum penetration of the acid before it is spent and withdraw the spent acid and insoluble residue to prevent clogging of the enlarged flow channels. Dolomitic formations require slow injection rates while fast injection rates yield better results in limestone formations.

Additives used include corrosion inhibitors to protect well equipment, demulsifying agents to prevent the formation of viscous emulsions between spent acid and oil, and surface tension reducing agents to facilitate removal of residual water.

Fracturing. Hydraulic fracturing increases the productivity of wells by creating or extending fractures into the reservoir to give reduced resistance to the flow of fluids. Graded sand is suspended in the fracturing fluid and is transported into the fracture to serve as a propping agent. The fracturing fluids may be thinned by dilution with reservoir fluids, by the effect of bottom-hole temperature, or by the incorporation of an auxiliary viscosity-reducing agent. The fracturing fluid base may be either oil, water, or acids and may take the form of emulsions, gels, or viscous oils. Most formations can be treated with oil-base fracturing fluids, whole thickened hydrochloric acids are often preferred in carbonate formations.

Hydraulic fracturing has shown phenomenal growth and has attained widespread acceptance by the oil industry for completing and reworking wells. Figure 4 graphically presents the growth of this process. At mid-1954 more than 2800 wells were being treated per month by this process.

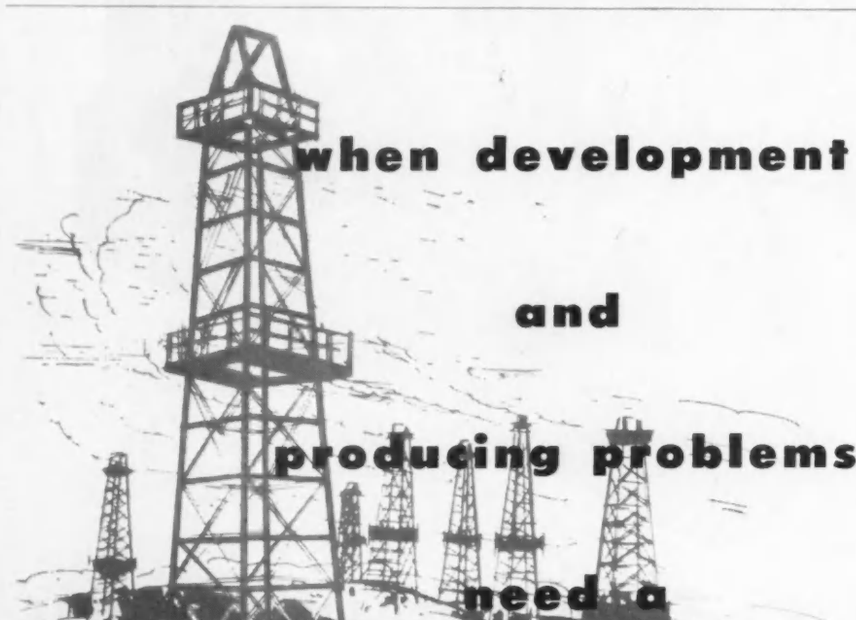
Recent improvements and modifications of this process are the development of:

Large-volume fracturing treatments create deep penetrating fractures having high fluid carrying capacity. This alters the oil flow pattern in the reservoir. Oil and gas thus only flow a short distance through the tight formation; the long flow path to the well is in the fracture.

In contrast, low-volume treatments are directed primarily at opening up

About the Author

A. L. SOLLIDAY obtained a degree in geology from the University of Oklahoma in 1923 and was employed as a scout by Dixie Oil Company. In 1925 he became a district geologist and when Stanolind Oil and Gas Company organized in 1931 he was promoted to superintendent of the Land department. From 1932 to 1944 he was manager of the Exploration department. In 1944 he was elected a director and vice president in charge of operations. In 1948 he became executive vice president.



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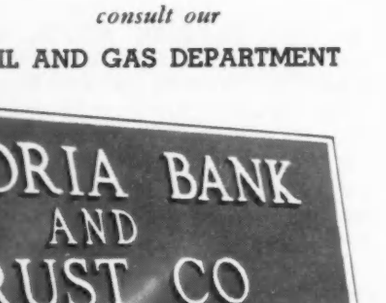

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an area of reduced permeability around the well bore.

The placement of fractures at selected depths in an oil-producing formation is often necessary as fractures formed indiscriminately in the well could extend into gas or water-bearing sections. Formation conditions might require a fracture at the base of the pay; other conditions would place it at the top; and even others might require several fractures throughout the section. In some cases vertical fractures are preferred

Specially designed packers can often be used to confine the fracturing fluids to the desired zones. Methods have also been devised to place fractures selectively in wells where packers cannot be used. At least two such methods appear attractive:

1. The penetrating fluid method places in the well a viscous, low penetrating fluid such as napalm-kerosene gel. A low viscosity, high penetrating liquid such as kerosene is pumped into the well through tubing and spotted at the desired fracture elevation. Pressure is then applied to the well until the rock is fractured. The fracture is most likely initiated at the elevation where the penetrating fluid is spotted. The fracture is extended and enlarged by following with the low penetrating fluid containing the propping agent.

2 The shaped charge method for placing fractures uses an explosive charge which cuts the formation circumferentially. The shaped charge is lowered to the desired depth of fracture, pressure is applied to the fracturing fluid, and the charge is detonated. The shaped charge not only cuts the formation, thereby weakening it, but also imposes a high transient pressure at that point. This aids in causing the formation to fracture at the desired location.

Maximum fracture flow capacity is obviously desired. Studies have shown that round sands having a uniform particle size are superior to common river sands for propping agents. Continued efforts are being made to improve propping agents. New materials being considered have high compressive strength, low density, and uniform size. With deeper wells and larger fractures, improved propping agents may be very important.

The trend toward large fracture treatments have increased the need for low cost hydrocarbon thickening

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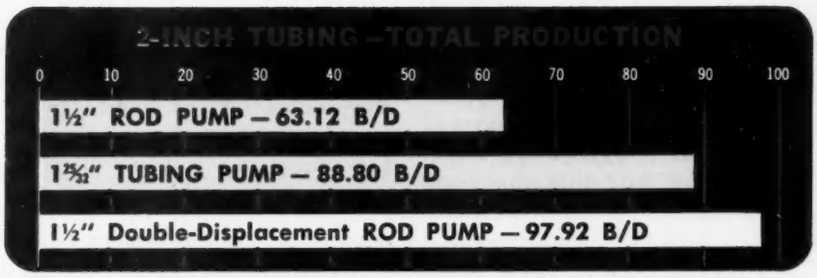
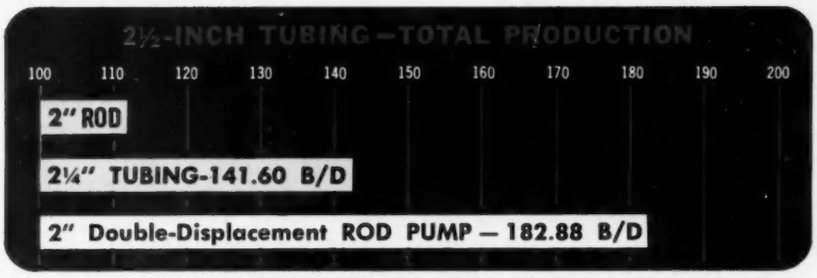
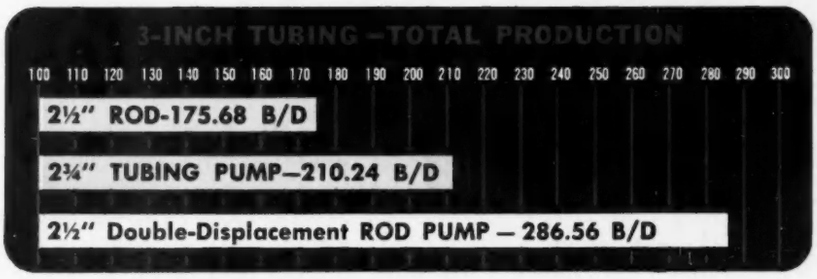

2-INCH TUBING—TOTAL PRODUCTION
0 10 20 30 40 50 60 70 80 90 100
1½" ROD PUMP — 63.12 B/D
1 25/32" TUBING PUMP — 88.80 B/D
1½" Double-Displacement ROD PUMP — 97.92 B/D


2½-INCH TUBING—TOTAL PRODUCTION
100 110 120 130 140 150 160 170 180 190 200
2" ROD
2¼" TUBING-141.60 B/D
2" Double-Displacement ROD PUMP — 182.88 B/D



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agents. Residual fuel oils are used extensively as a fracturing fluid in large volume treatments. Fuel oils occasionally remain too viscous while in the formation, resulting in a slow return of the treating oil from the formation and occasionally, backflow of the propping agent to the well.

Where viscous oils are not satisfactory, a self-liquefying oil-in-water emulsion has been developed. It is prepared by emulsifying crude oil or other hydrocarbon liquids in a small volume of water with fatty acid amine salts as the emulsifying agent. An acid-forming chlorinated hydrocarbon acts as a destabilizing agent causing viscosity reduction in the formation.

Multiple fractures from a single treatment are sometimes desirable. Slugs of temporary lost circulation materials (oil soluble) are added to the fracturing fluid, and so spaced that the fractures previously opened are temporarily plugged by bridging. The fracturing fluid following each slug then opens a new fracture.

Fractures can often be made either vertical or horizontal. A quick buildup in injection pressure in a nonfractured section will tend to form vertical fractures. The gradual buildup to breakdown pressure is more likely to create fractures along bedding planes. The viscosity and fluid loss characteristics of the fracturing fluid are also factors in controlling the direction of fractures.

Other Stimulation Methods. Other stimulation methods, such as the use of "mud acids," surface tension reducers, paraffin solvents, and bottomhole heaters, have experienced varying degrees of success. They are not, at present, considered major stimulation methods.

A method that shows promise uses special surfactants in an oil solution to remove water block from the formation adjacent to the well bore. Only a few surfactants of many are known to reduce oil-water interfacial tension to near zero.

COMPLETION EVALUATION

A major factor in well completion is the determination of the degree of success obtained by the procedures and stimulants used. The measure is qualitatively reflected by the ability of the well to produce, expressed in terms of productivity index (barrels per day per pound per square inch pressure drop).

Recently, progress has been made in determining well characteristics from pressure buildup and drawdown tests. These concepts have been applied to evaluate quantitatively completion efficiency. By means of a pressure drawdown test, the productive capacity of the formation near the well can be measured.

After a pressure buildup test, the productive capacity of the formation in the interwell area can be calculated. A comparison of the two productive capacities indicates if the well completion program has damaged or improved the producing capacity of the natural formation. The ratio of the capacity nearby to that far away from the well is termed the completion ratio.

Damage caused during well completion is shown by a ratio less than one, indicating the improvement to be expected from future stimulation. Fracturing and acidizing often result in ratios greater than one.

Summary

Modern well completion has become a refined technique. Progress has been made in preventing and overcoming damage to permeability during drilling-in or later completion operations. Oil-base, oil-water emulsion, and non-clay-hydrating muds have minimized formation damage due to water, while the use of gas or oil as drilling and perforating fluids has, in addition, reduced damage due to solids intrusion.

Development of tools and procedures to eliminate the need of the drilling rig during completion and reworking operations has fulfilled a great need.

Hydraulic fracturing, a recent innovation in well completion and stimulation, has found widespread use is overcoming formation damage around the well. Almost 35,000 fracture treatments are performed per year. Fracturing is being extended to change flow patterns in a well's drainage area, particularly in very tight reservoirs.

Many improvements have been made in sand control, acidizing, shooting, and special chemical treating processes. All have their specific application and warrant careful selection.

The industry can expect further progress in well completion technology as the benefits of those techniques now in use are better appreciated.

ACKNOWLEDGMENT

This article is a digest of a paper presented at the Fourth World Petroleum Congress, Rome, Italy, June 6-15, 1955. Publication by courtesy of the publisher, Carlo Colombo, Camp Marzio 74, Rome, Italy. Complete text will be published in proceedings of the Congress.

Directional Wells

Continued from Page 214

propeller and an eccentric mechanism, have been constructed but are still in the formative stage.

Service Work. The major problem in producing directional wells is cleaning out the sand from inside the production liners. This situation frequently occurs in completions of soft sand multipay zones, such as those at Huntington Beach. Where normal or reverse circulation with oil or salt water is attempted sand is not removed but lays undisturbed on the low side of the hole. If mud is circulated with sufficient fluid velocity, sand and cuttings can be removed. As mud has detrimental effects on the oil sand conventional bailing is largely employed. Filling the hole with light gravity crude or replacing the entire hole fluid with light gravity crude facilitates running a bailer.

Pulling and running tubing manifests the effect of friction by the difference in forces required. In the high drift angle well, or low drift angle well with dog-legs, extreme loads can be imposed on the production derrick with but little or no pull reaching the bottom hole assembly. When pulling the tubing, a force of 30,000 pounds in excess of the tubing weight is common even after initial movement has commenced. In extreme cases 60,000 pounds above the tubing weight may be necessary for the first few hundred feet of pulling. As the full load must be applied on the top tubing joints, design of the tubing string must include joints of high tensile strength in the top hole section. When running in the hole, it is common for the entire tubing weight to be off the tubing elevators.

Washing perforations with a cir-

culation type washer has been undertaken in some low drift angle wells. However, the problem of lifting sand to the surface makes circulation washing impossible in high drift angle wells. Down-the-hole washers have been used wherein no circulation to the surface is necessary for effective operation.

Reservoir Mechanics. A common question regarding the oil recovery from a directional well is whether a perforated liner passing through an oil zone on the diagonal, such that as much as four times the normal thickness is exposed to the perforations, will recover more oil. It is believed that this diagonal penetration will not, in itself, improve unit recovery of a given acre foot of reservoir volume, but it does change the reservoir volume exposed to a given well. Instead of the conventional vertical cylindrical drainage area of a straight well, the directional well in an extreme case, where little stratigraphic progress is made and vertical permeability exists, will drain an oblique rectilinear box.

Where a directional well pierces an oil structure such that it penetrates the gas cap, oil interval and water horizon, production control measures can be very troublesome. Difficulty in effectively cementing blank intervals in the liners and the hazard and disadvantage of using production packers adds to the problems. On the other hand where a well penetrates, or can be planned to penetrate, an oil structure such that it misses the gas cap and includes all the oil interval farthest removed from edgewater, production control problems are at a minimum.

A reduction in fluid velocity through liner perforations in a directional well results from the oblique penetration of the zone and an abnormal sand thickness exposure. Because of this lower velocity there should be a reduction in sand flow and less likelihood of perforation erosion. On the other hand this could be a disadvantage when a well is cleaning up during initial production. Insufficient pressure differential across some of the perforations permits the drilling mud to permanently plug those perforations.

One possible application of directional drilling could apply in developing a field where the zone existed a 30-degree dip, for instance, and the sand had vertical permeability. A 60-degree drift angle well would be drilled to follow the dip of the formation with the single well replacing an entire line of wells.

Other applications of directional drilling to enhance reservoir recovery efficiency would be the planning of wells to utilize inherent recovery forces for the particular pool. For instance, in a reservoir where gravity drainage is the predominant recovery mechanism, the well should be planned so that the liner would be placed in a down-structure position.

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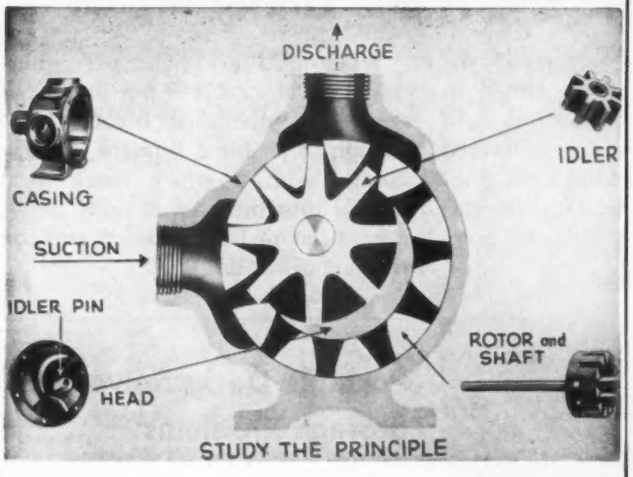
Viking Operating Principle



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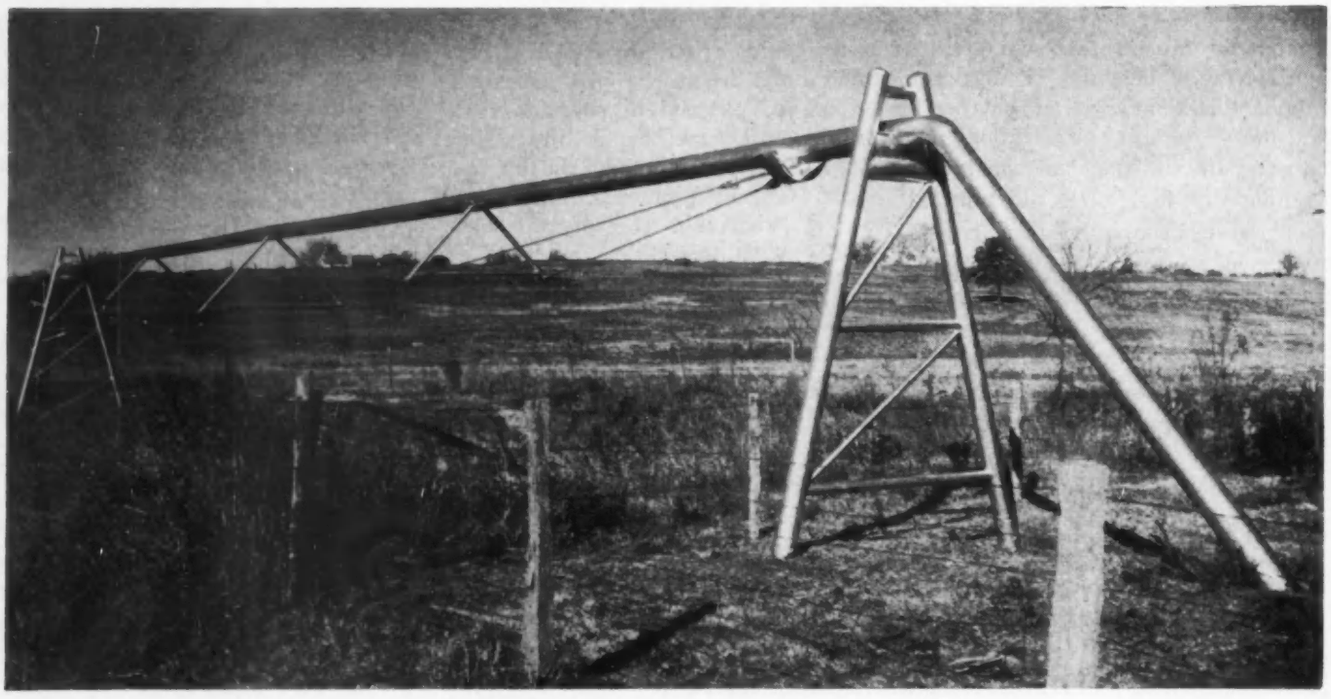
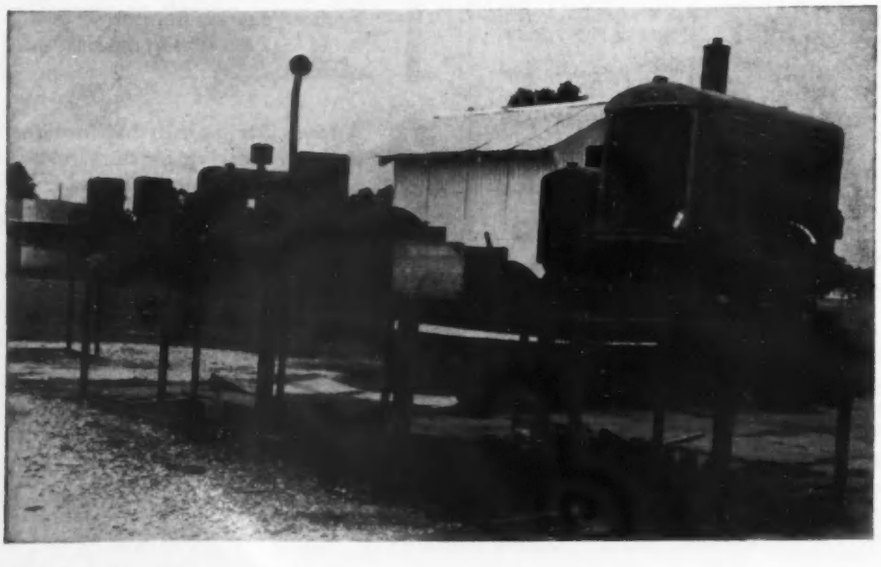


Creek Crossing Supported by Cable and Frame Under Pipe

A simple creek crossing may be built by placing supporting members under tension beneath the pipe rather than having a catenary above. To construct it, A-frame supports are set in cement on each side of the creek, well back from the bank.

Pipe is pulled across the creek and triangular frames are welded to the bottoms as shown. Holes drilled in the lower section of the frames hold ¾-inch wire cables. A plate is welded and braced on each end of the swinging joint. Bolts fastened to the ends of the cables pass through the holes in these plates.

When nuts are tightened against the plates the cable is put under tension. The pipe then becomes rigid enough to be lifted into the A-frame saddles with a winch truck. It is welded into the line using 45 degree risers to allow for expansion and contraction of the line.



Portable Docks Solve Storage Problems

During periods of drilling activity or lease construction work there is often some difficulty in finding storage space for materials and equipment that should not be left on the ground. Items such as flanges, ground surface pulleys and portable engines are subject to corrosion, dirt and moisture.

One company has solved its outside storage problem by fabricating a

number of portable docks. Each one is four feet high, five feet wide and ten feet long. They are made of scrap 2-inch pipe and floored with rough oak lumber. When placed end to end as shown, they form an ideal unloading dock at about the height of the bed of a bobtail truck.

Equipment can be loaded and unloaded with a minimum of effort, and all materials are kept up off the ground. When the period of drilling or construction activity is over and the surplus material can be moved, it is a simple matter to load these temporary docks and move them to the next location or store them until they are needed.

Compressor on Rubber Belting Reduces Vibration

Compressor vibration can be eliminated by setting the base on pieces of rubber cut from belting material. To get the full effect of the cushioning material, eliminate hold-down bolts; instead, use turnbuckles to hold the base stationary and take up belt slack. Plates welded to the bottom of the skids keep the unit from moving sideways.

Two I beams first are grouted into the concrete floor. Skids are fitted with strips of metal so that the base cannot move sideways, yet is free to slide back and forth on the rubber cushions. Turnbuckles are then fitted into the sides of the skids and the ends of the beams as shown. When tightened, the turnbuckles will give proper tension to the V-belts and prevent the base from creeping.

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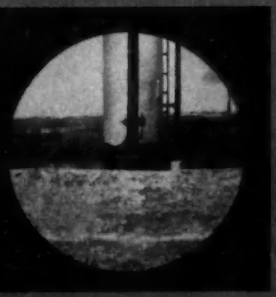

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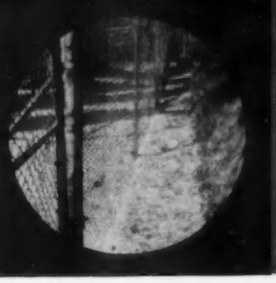

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Gravity Feed Lubricator Increases Life of Rods

In one East Texas oil field, a simple gravity feed lubricator has been placed in operation on a 24-hour water pump with twin pistons. The water, heavily laden with salt and sulfur, is hard on rod packing and rods. The gravity feed lubricator keeps a constant flow of oil going to the packing of both rods and greatly increases their life.

A five-gallon can was drilled out to accommodate a ¼-inch pipe at the bottom. A nipple was welded in this hold and a valve and tee screwed into the nipple. From this tee, two ¼-inch copper tubing sections were run to the rod packing, making sure that the bends in the tubing were downward and free from kinks. The valves can be opened to the desired flow, and the only maintenance is the refilling of the five-gallon container by the pumper on shift.

Since there is no noticeable change in the pump load from time to time, there is little or no adjustment necessary once the valve has been set. The container may be increased in capacity, depending on the size of pump in service.

Gas Tank Installation Shielded by Steel Cover

The gas tank installation pictured here, which is used for fuel on a work-over rig mounted on the back of a truck, is shielded by a steel cover. The jacket is open on both ends and reinforced on the top side with angle iron welded to the cover. The line from the tank to the engine runs through an opening cut in the jacket and the fuel passes through a filter bowl. This bowl is in sight so that it can be emptied if sediment settles in any quantity. The height of the tank, which is mounted on steel angles behind the truck cab, allows more positive flow due to the increased pressure brought about by gravity. With both of the ends of the jacket open, the tank may be removed easily for servicing when necessary.

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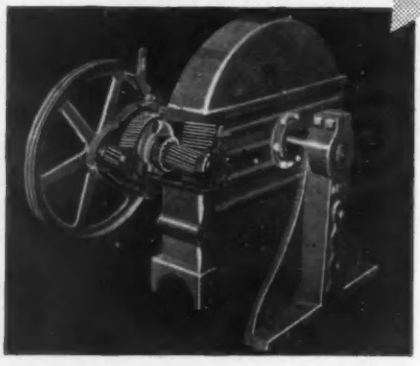

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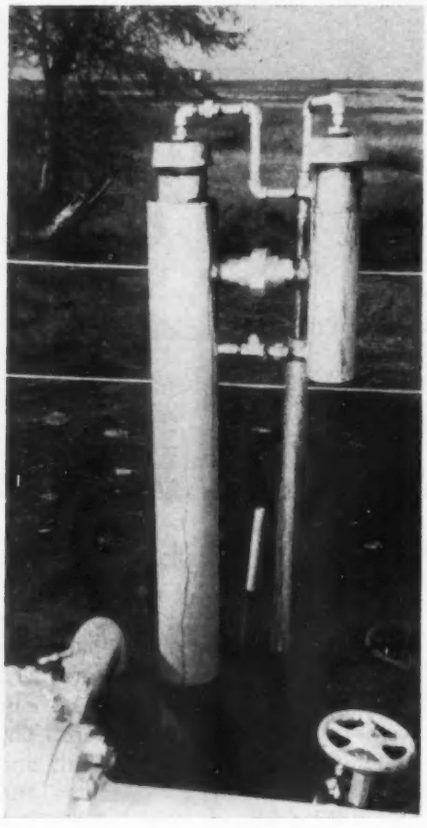


Shop-Made Float Chamber Prevents Gas Lock on Pump

A shop-made chamber fitted on the upstream side of a field pump will keep air from entering the pump and causing an air lock. The float chamber is connected to the side of a riser on the suction line with a union and a blind flange as shown. A check valve in the lower half-inch line allows the vessel to drain.

The upper line serves as a vent line; as long as air or gas is in the riser it will pass out through the top of the float chamber. When the riser fills with liquid, the float inside the chamber rises and cuts off the flow so the pump will carry liquid. When another slug of air or gas enters the riser, the float valve will open and vent it.

The float chamber is connected to a sump to take care of any leakage through the float valve.

TexPet's Unique Rig
For Amazon Operation

Rigged up for testing at Tulsa, the specially-designed drawworks and power package trailer have been moved into operating position and pinned together and the mast is being raised.

Special wheel-mounted equipment was engineered for the Maranon valley test astride a 7000-foot Andes pass.

By ANTHONY GIBBON
World Oil Staff

A specially designed track-mounted rig destined for operating in the jungle area of the headwaters of the Amazon river recently completed a 5500-mile trip from the U. S. to mark the beginning of some of the most interesting and difficult explorations for oil in the Western Hemisphere.

The rig was ordered by the Texas Petroleum Company in Peru, a 100 percent owned subsidiary of The Texas Company, and a flotilla of small craft was required for the two-month voyage from Trinidad down the east coast of South America to Brazil, and 1950 miles up the Amazon to its headwaters.

Although the Pacific Ocean is only about 450 miles away from the drilling area, the rig was towed the long way around because it was impossible to dismantle and haul the equipment over the trackless Andean mountain range that lies between the Pacific and the city of Iquitos.

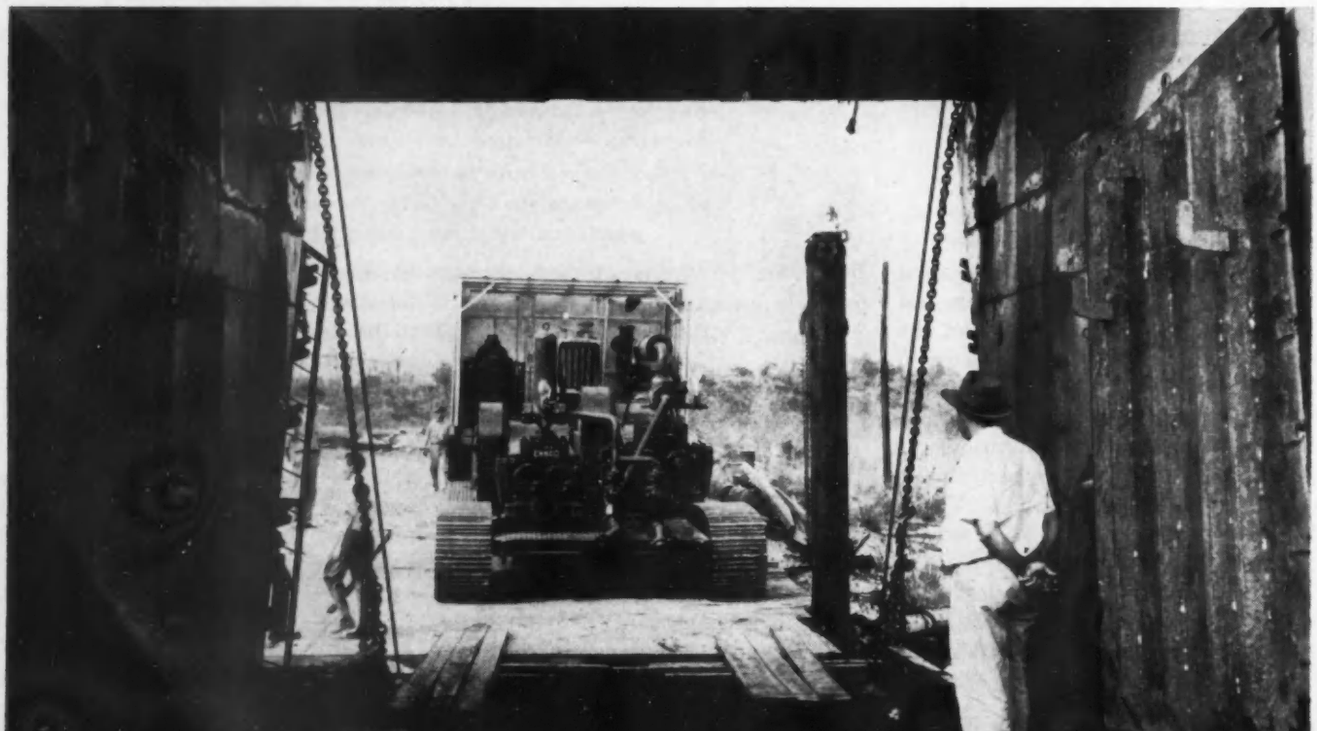
The rig will drill on a 2.5-million acre concession that TexPet holds in the Maranon river valley of Peru. It will operate in the Amazon Basin without the use of automotive equipment, all units being wheel mounted to be tractor-towed. The rig was transported to Peru aboard TexPet's LSM Putumayo. Moves along the Maranon river will be made on the LSM. Because of excessive rainfall and river mud conditions, all packages had to be designed with a minimum weight, but still heavy enough to do the drilling.

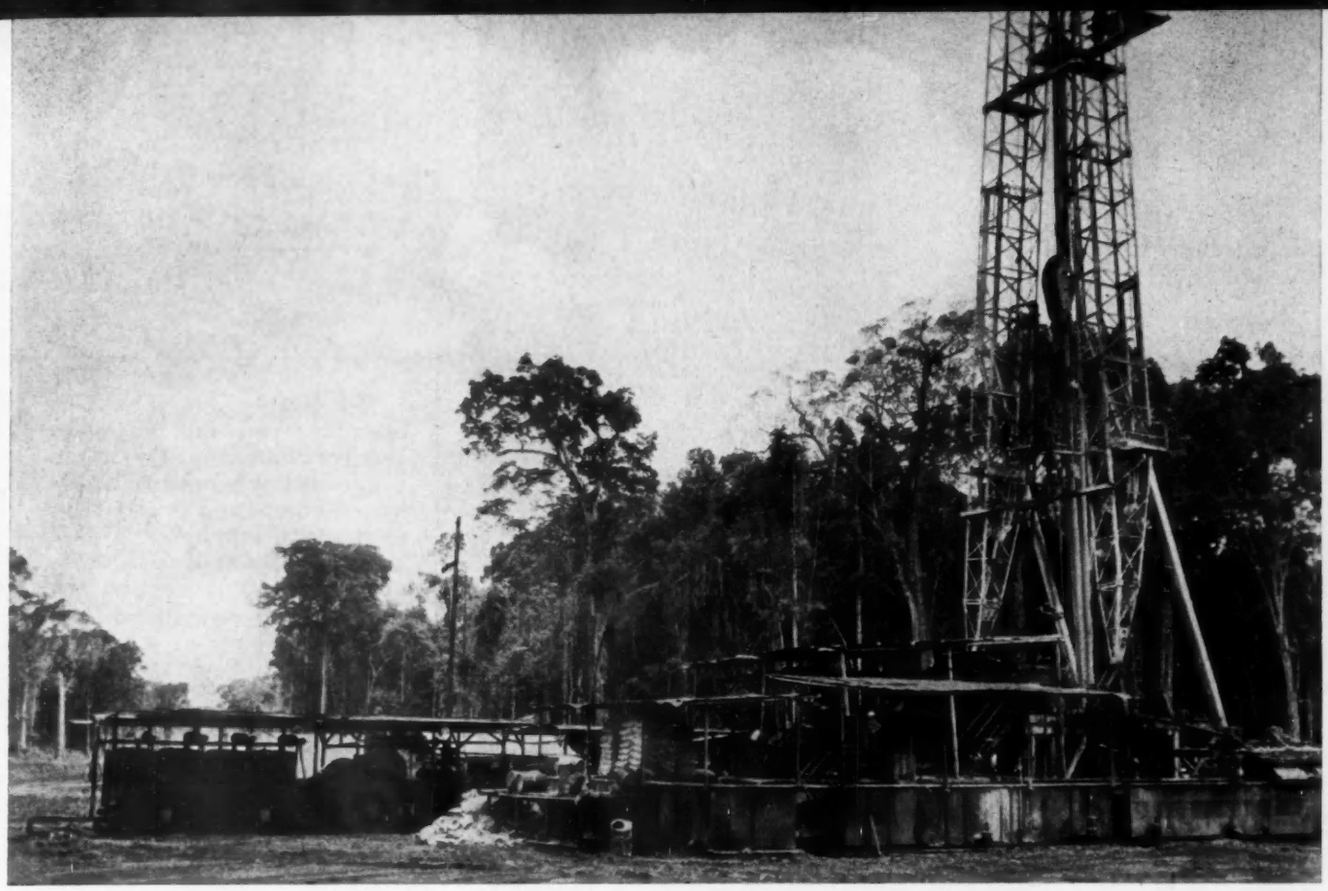
The rig consists of a 400-horsepower drawworks, powered by diesel engines equipped with torque converters, compounded through a four-

Here, the engine package consisting of power trailer and engines and compound, fuel oil and lubricating oil tanks is being hoisted aboard TexPet's LSM Putumayo.

Photos courtesy Mid-Continent Supply Co.

The track-mounted slush pump begins to roll aboard the Putumayo.





This cleared location is in the Maranon river valley of Peru, where TexPet plans a drilling program on a 2.5-million acre concession.

engine drive unit. Air clutches are used to connect the engines and torque converters to the chain compound.

The ramp opening on the LSM governed the height and width of all units inasmuch as the rig will be towed on and off board through this opening.

To cope with transportation difficulties on the long voyage, the unit was divided into four packages:

- Drawworks unit and trailer consisting of the drawworks, rotary table and rotary drive.
- Power trailer consisting of four engines and compound, 300-gallon fuel oil tank and 75-gallon lubricating oil tank.
- The 97-foot telescoping mast trailer.
- The slush pump trailer and pumps, generating set, accumulator unit and two air compressor units. Pump manifold is assembled on and moves on this trailer.

The most unusual part of this rig design lies in separation of drawworks and power units. Because of weight limitations, it was necessary to break the drawworks and power into two packages. This was accomplished by mounting the drawworks on one trailer and power on another trailer, with provision for pinning the two together in the operating position. Because of the light weight of the pumps, it was possible to unitize both pumps onto one trailer, which made possible a compact mud manifold which does not have to be disassembled for moves.

To assist in the loading and unloading process, an independently engine-powered winch is utilized. Once the units are loaded on board the LSM, the winch tows them into their proper position. The winch is removable in the event it is required to assist the tractors in the rig movement to and from the well deck of the LSM.

To minimize the amount of equipment required for this drilling operation, the drive group was designed to include two pump drives utilizing universal joints to transmit power from the drawworks drive group to the two slush pumps, greatly reducing the number of engines required, but still providing independent pump power.

This TexPet operation is probably one of the most difficult encountered in modern times and the rig design one of the most unique.

Great care was exercised in furnishing equipment engineered specifically for the job.

Despite the formidable barrier posed by the Andes mountains between its concession and the Pacific, TexPet does not discount the value of its concession. The company chose the Maranon valley as the site of its exploratory program because, among other reasons, it lies right at the gates of one of the few accessible passes through the Andes. This 7000-foot pass is the lowest in the entire main mountain range where snow-capped peaks tower above 20,000 feet. If large reserves of oil are found, the construction of a crude oil pipe line through this pass to the seaport of Bayovar might be justified. Situated on the coast of Peru, the port is sheltered from strong prevailing southwest winds, and is one of the best natural harbors along the western shore of South America.

About 600 miles south of TexPet's nearest production in Colombia, Maranon valley lies in the heart of the great geological basin of the upper Amazon where the only oil in commercial quantity has been found hundreds of miles to the south.

ACKNOWLEDGMENT

The writer wishes to thank Texas Petroleum Company, Mid-Continent Supply Company and Victor LeMay for supplying the information and pictures for this article.

BUNGALOWS LIKE THIS one built by Iraq Petroleum Company for its employes exemplify . . .

A CAMP CITY PROFILE

This feature, one of a series describing important oil camps or cities throughout the world, is intended only to describe living conditions and to give a bit of the local atmosphere. While an occasional one of the features may touch lightly on working conditions, it will do so only incidentally.

Staff club library contains thousands of books, in English, Arabic, and other languages.

Comfort at Kirkuk

One of the world's oldest cities, Kirkuk has a past that belongs more to the archaeologist than the historian. But the discovery of oil has led to a modernization of the ancient.

THE AIRCRAFT loses height. The bland terrain below sharpens into focus. Things begin to appear on it—an oiled road, telegraph poles, grazing camels, a black-tented Bedouin encampment. For an hour you have read books, dozed, or talked with fellow-passengers, for there has been nothing on the ground to hold your interest. Nothing save the wilderness of arid, buff earth stretching endlessly away into the haze of distance. You flew over two rivers, the Euphrates and the Tigris, and marked the ribbons of cultivation along their banks. But that has been all.

But now, you stir expectantly and peer ahead.

Most insistent upon the landscape is a ruching in the otherwise dead flatness of the desert. It is a line of low, gaunt and barren hills that runs north and south and forms a backdrop for the industrial and communal setting that begins to assume an identity as it emerges from the heat haze. Gliding nearer, you can pick out installations as their silvered steel gleams in the sun, clusters of neat gray stone buildings, patches of green that make up a vast straggling oasis. groups of trim little bungalows, a network of black oil roads. You can even see a tank farm and a spider's web of pipes. A typical oil town.

In the distance, to the right, you

This club near center of town is provided by IPC for local employes.

Wheatley House is a gathering place for students. IPC trains its own technical and administrative staff drawn from young Iraqi students.

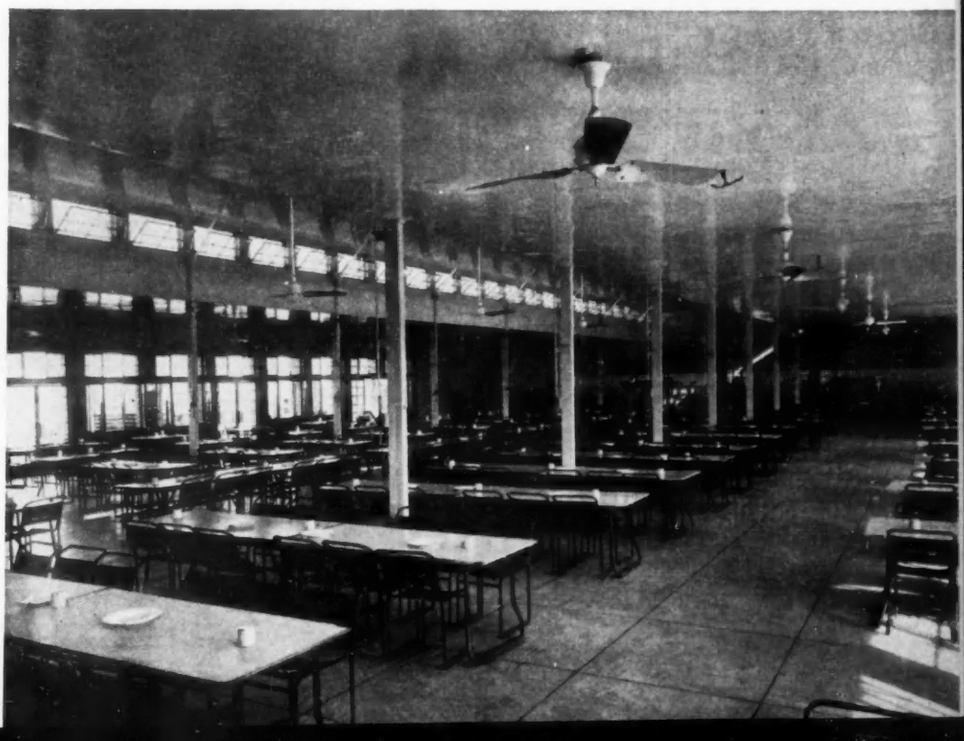
Students at work in the Kirkuk Industrial training center for workshop employes.

linked, though somewhat tenuously, with fabulous Babylonia, with such noble cities of earliest civilization as Nimrud, Nineveh, Hatra, and even with Babylon itself; it treasures within its walls a tomb of Daniel; its Old Mosque overlooks, from only a short distance, the dancing, whispering flames of the "Eternal Fires" where, reputedly, Shadrach, Meschach and Abednego underwent their ordeal; while, hard by Kirkuk, Professor Braidwood of the University of Chicago has recently uncovered the remains of Jarmo, probably the oldest village in the world, and its first attempt in organized society after cave life.

In retrospect, Kirkuk contemplates the agricultural richness of ancient times that was sustained by a remarkably scientific irrigation system harnessing the twin rivers, Euphrates and Tigris. It recalls the ravages of invading Mongols and great floods and the confused and hapazard economies of a succession of ill-advised conquerors who neglected, even deliberately destroyed, the life-giving water system. And it has watched, over many turbulent centuries, deterioration of rich lands around it into desert.

Then, finally, it more recently recalls the discovery of oil within the

Continued on Page 285



Employes canteen (below) seats 500 and serves subsidized meals at a fraction of cost.

can distinguish the citadel-like pile of the ancient city of Kirkuk and the tangle of the newer suburbs around it. Contemplation of it impels your mind and imagination into the distant past, for there is much more to this place than oil.

Long history. Kirkuk is one of the oldest cities in the world. All that went before belongs to the archaeologist rather than the historian. It is

Pupils of Compania Shell de Venezuela's trade school at Lagunillas practice electrical work.

Postwar expansion put a great strain on the demand for operating personnel, but through training programs such as this . . .

Venezuelans Are Learning About the Oil Industry

By WILLIAM A. JANSEN,
Training Coordinator,
Compañía Shell de Venezuela, Caracas

THE COMPANIA SHELL DE VENEZUELA has an elaborate training scheme for its Venezuelan staff and workers. Although some systematic training has been provided for certain categories of workers since before World War II, the great push in training matters has come during the last five or six years, mainly as a result of the considerable expansion of operations since the war.

Two factors have been of great assistance in the development of this scheme:

- The Venezuelans' natural intelligence and eagerness to learn.
- The world-wide experience of the Shell organization in matters of training.

It is because of the fortunate combination of these two conditions, as well as the complete training-mindedness of Shell directors and executives that the program is developing successfully. (See Table 1.)

The present-day spectacular development of Venezuela in new industries, communications, agriculture, building construction, aviation, public works and other fields, causes an ever-rising demand for skilled labor, technicians and professionals. It is the natural desire of the Venezuelan government to satisfy this demand as much as possible with Venezuelans. Considering the average time required to teach a graduate of primary school a craft—four years—or a profession—nine years—it is clear that in this particular period a shortage of almost every category of trained people prevails.

Consequently, large-scale training programs are essential. At the same time, the lack of experienced men tends to stimulate quick promotion for those who are outstanding in their field.

Three-Phase Program. Venezuela has the following systems of education: 6 years of primary school, 4 years of high school, and 1 year of university preparatory studies prior to university studies varying from 4 to 6 years. School attendance is obligatory. Each of the three universities in the country has an engineering faculty, and there are several vocational schools where industrial technicians are being educated. Expansion of specialized studies and the importance

TABLE 1

The following number of Venezuelans undergo special training by Shell:

University scholarships	106
Technical school scholarships	42
Nurses scholarships	24
Shell trade pupils	329
Draftsman course	19
Surveyor course	9
Power plant operator's course	16
Radio technician course	6
Assistant to petroleum engineer course	13
Gas plant operator course	8
Pipeline operator course	12
Refinery operator course	60
Ships engineer course	13
Salesmen's course	7
Refinery recapacitation course	38
During 1953 the following numbers of personnel received:	
Supervisory training (TWI)	1,388
Language courses	1,092
Driver's safety courses	79
"Pool training"	69
Special courses abroad	17

attached to education are reflected in the establishment of new university buildings, military academy, nurses schools, agronomy schools and many others throughout the country.

The training program of the Compañía Shell de Venezuela can be divided into three main groups:

1. Training and educating of young people to learn a craft or a profession.
2. Training of employed personnel at special courses to improve their knowledge of their job or to prepare them for a better job.
3. General on-the-job training.

1. Professional and Craft. To the first category belong all those studying through company scholarships. A careful selection is made among boys who have graduated from primary school or high school. Those accepted receive complete technical training free at the Shell Trade School in Lagunillas oil field or at government technical schools. A number of selected high school graduates who are eligible for admission to a university receive scholarships for their university studies. Similarly, a number of girls study at nurses schools with the benefit of Shell scholarships.

Living quarters and classrooms for trainees at Shell's Lagunillas and La Conception oil fields in western Venezuela.

Further, Shell organizes special courses for draftsmen, surveyors, power plant operators, and radio technicians. It is the company's policy to use, whenever possible, existing institutions; however, particular requirements of certain jobs have made it desirable to establish specific courses for the training of these candidates. This is, for example, the case with geological draftsmen. For other categories such as power plant operators, it is considered valuable to have these future operators in hand for many years before they will be placed in positions of high responsibility. A five-year course gives an excellent opportunity to teach necessary discipline and sense of responsibility as well as the technical knowledge required.

Shell trade school students at work in shop. There is a strong demand for graduates of the school in all operating departments.

Lagunillas Trade School. The company Trade School has the advantage of being located in the heart of the oil fields next to the maintenance and overhaul shops, where students can get acquainted with actual equipment during the hours of practical work, which are part of their curriculum. Students at this school are mostly boys from the oil areas and second generation oil workers. In addition to mathematics, physics, technical drawing, etc., their curriculum includes humanities and cultural subjects.

During the three-year course at this school they can specialize in such trades as shop machinists, automotive

Venezuelan students are sent to study in foreign countries to broaden their outlook. Here a Venezuelan student studies at Loughborough College in England.

mechanics, electricians, etc. The company provides living quarters, and the boys receive an adequate allowance for their living expenses during their study period. This school, which was founded in 1946, has been successful and there is a strong demand for its graduates in all operating departments. The enrollment is a little more than 300. Admission is subject to a competitive examination.

Lagunillas Trade School runs several other courses. One of them is for high school graduates who are being trained for semi-technical non-graduate jobs in such departments as transportation, materials, production, etc. At the same time, school facilities are being used for recapacitation and other special courses. Several outstanding graduates of Lagunillas Trade School have been granted scholarships for further studies. They have been sent to the Universities of Santiago and La Concepcion in Chile, where they can obtain the degree of "Industrial Technician" after three years' study and which degree is one step below the university degree of mechanical engineer in that country.

University students who study with Shell scholarships not only receive the money to study, but also guidance on their studies (see Table 2). This is something that appears to be highly appreciated by the parents, some of whom do not seek the Shell scholarships for the sake of the financial assistance as much as for this guidance. There are no strings attached to the scholarship save insistence on good progress in the academic side and good conduct. The graduate is free to choose whether he wants to join Shell or take any other job.

Attractive conditions and interest in his country's No. 1 industry should lead him to work for the company that helped him with his studies, rather than simply a signed contract. Moreover, every graduate is an asset to Venezuela and, indirectly, an asset to its major industry.

Foreign Study Offered. Venezuelan universities have excellent courses in civil engineering and the newly-founded Department of Petroleum Engineering at the Universidad del Zulia in Maracaibo promises to produce equally well-educated petroleum engineers. The same high standards have been achieved in medicine, law, agronomy, and economics. The departments of chemical, electrical, and mechanical engineering, however, have not yet been fully developed and, therefore, students in these branches of engineering are being sent abroad. There are some scholarship students of civil and petroleum engineering at foreign universities, but they are there for specialized study not presently available locally.

TABLE 2

Number of Venezuelan Shell scholarship students studying:

	In Venezuela	Outside Venezuela
Civil engineering	8	7
Mechanical engineering	..	12
Chemical engineering	..	10
Petroleum engineering	10	15
Electrical engineering	..	6
Geology	1	7
Agronomy, forestry	1	4
Industrial techicians	..	6
Medicine	9	1
Pharmacy	1	..
Laboratory analysts	2	..
Law	2	..
Economics	1	2
Accountancy	..	1
Technical schools	36	..
Nurses	24	..
Preparatory and high schools	2	5
Miscellaneous	3	4
	100	80

Some 70 Shell students study in the U.S.A. at 20 different accredited universities. Each year Shell's training coordinator, who is responsible for their studies and welfare, visits all of them and discusses their study problems with their professors. Thus, a check is kept on their progress, practical work or summer-school courses, etc. After two years abroad, the students are given free passage to Venezuela to spend a vacation at home, combined with some practical work in the oil fields or refineries.

Similarly, there are Shell students studying in England and other European countries, as well as in Colombia and Brazil. It is of great benefit to a Venezuelan student to have spent some time outside his country, having learned, usually, to speak English fluently and, more importantly, to have broadened his mind in the way everyone does who has traveled.

2. Skilled Training. The type of training of employes who undergo special courses comprise such categories as assistants to petroleum engineers, advanced draftsmen, gas plant operators, ships engineers, salesmen, refinery operators and several others. To this category also belong the language classes, the supervisory training (TWI) courses and the so-called "pool training" for professionals.

Apart from that there are employes who undergo special courses outside Venezuela, namely, in the USA, the U. K. or Holland. All these courses are not considered as on-the-job training, as the trainees are not doing primarily productive work while attending the courses.

Assistants to petroleum engineers are trained to do the routine work of the petroleum engineer, freeing the latter for more scientific work. It appears that their training has been successful inasmuch as those who have

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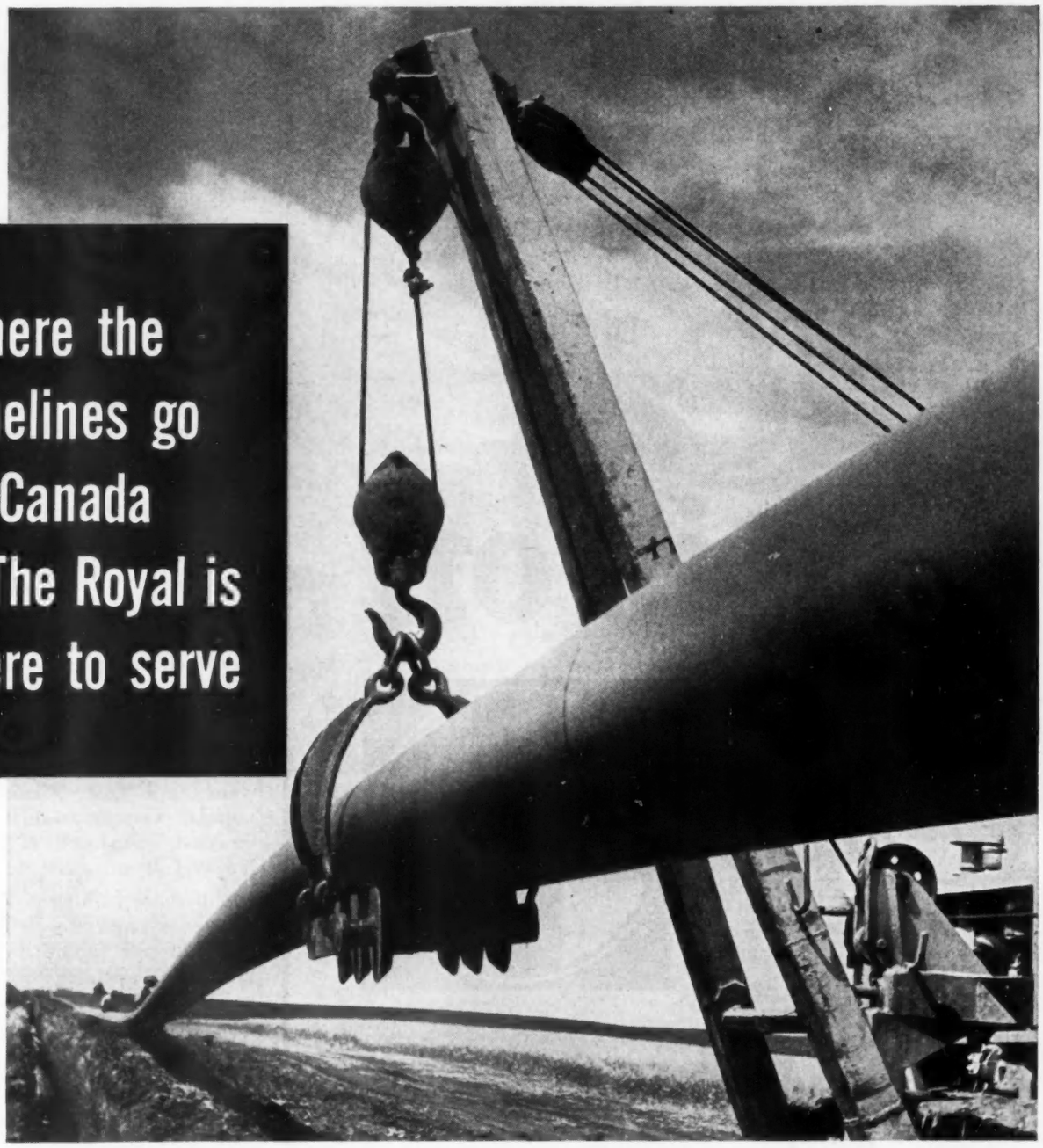

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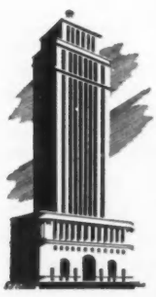

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completed the course are fulfilling direct needs competently. Requirements for admission to this course are high and candidates have to be in possession of high school certificates and have to have knowledge of English.

Candidates for the other courses such as gas plant operators, refinery operators, etc., are usually chosen from men already on the job as helpers or assistants. These men have already proven their capabilities for their future positions. The number of failures in these courses is small as careful selection is exercised before they are admitted. For each of these courses a program has been drawn up with time schedule and detailed curriculum. Instructors are invariably senior employes who have been made available, either full-time or part-time, to give instruction to these trainees.

Shell demands a good working knowledge of Spanish of their non-Venezuelan employes and provides Spanish classes for them and their families. Also, the study of English is stimulated for Venezuelan staff, who can benefit from company-sponsored classes in English. These courses are popular. Venezuelan oil workers realize that knowledge of the English language is an asset.

Supervisory training TWI courses have been given to a large number of the Shell staff. Job instruction, job relations, job methods, conference leadership, have been or are given in English and in Spanish.

Indoctrination of Engineers. A very important part of Shell's training schemes is the training pool for technical graduates. This scheme provides the opportunity to every newly-engaged engineer to spend some time in each department and to have an idea of the complete activities in a particular area before he begins his productive work in his own department. It has been found that the increased efficiency of a man once he begins his work easily offsets the cost and the loss of time of this training period.

In the past it took many years to become acquainted with the work of other departments. Experience was gained by trial and error. Potential executives in the organization frequently lacked knowledge of operations other than their own. The training pool eliminates these drawbacks

About the Author

WILLIAM A. JANSEN is well qualified as training coordinator of a large oil company due to his years of experience as an engineer in foreign service and as a university professor. A native of Holland, Jansen graduated in 1925 from Delft University with a degree in civil engineering. Prior to joining the Shell organization in 1935, he worked on irrigation projects in Java. One of his earliest engineering specialties was the development of bituminous products for dyke revetments. In 1938 he was sent to Venezuela to build dykes in the area on the Lagunillas oil field at Lake Maracaibo and later became Shell's chief civil engineer in Venezuela. In the early postwar period, 1945 to 1947, Shell sent Jansen to Borneo to aid in reconstruction after which he returned to Venezuela to develop foundations for Lake Maracaibo drilling operations. During this time, and for five years prior to being named training coordinator for Compañia Shell de Venezuela in 1952, Jansen was a professor at the University of Maracaibo, teaching hydraulics and mechanics.

and prepares every newcomer for better understanding. An added advantage is that each young graduate has the possibility of being assigned to the department for which he is best suited.

A civil engineer ending up as a geophysicist, or an electrical engineer finding his vocation in drilling equipment are no exceptions. Each pool trainee follows a detailed program and reports on his work in the various departments. The general opinion of these trainees: it takes too long before they start on productive work. However, they themselves do not always realize the benefits of this train-

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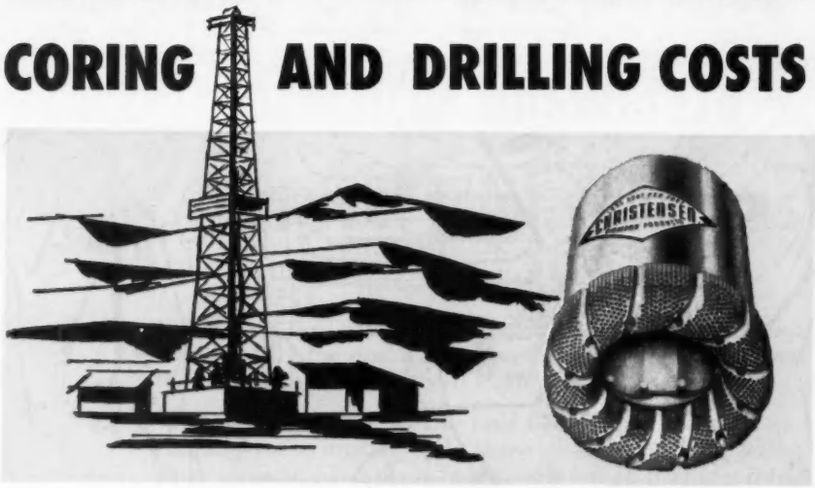

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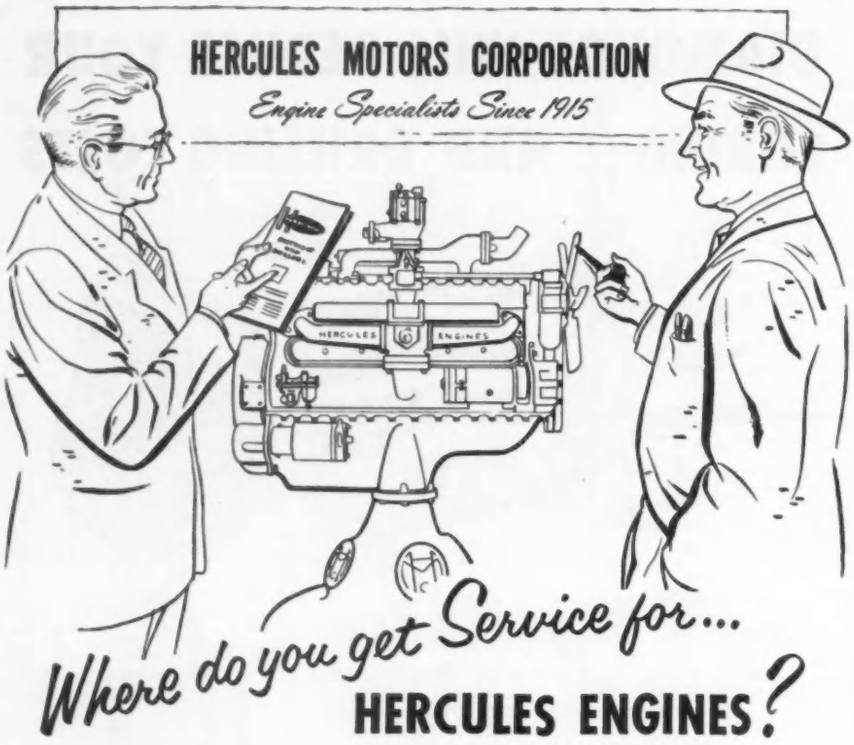

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ing before they are well established on the job. Senior administrative staff receives a similar, reduced, pool training.

The continuous stream of trainees coming into the always-busy field departments requires complete cooperation by these departments to make the training a success. In 1953, about 69 pool trainees have gone "through the mill." To reduce the inconvenience to operating departments, trainees have been combined in small groups. Accommodation difficulties have been solved by the construction of trainee centers in two areas—buildings with bachelor apartments upstairs and classrooms and a large lobby on the ground floor, fully equipped with film projectors and necessary training aids.

Training of employes in courses abroad is a matter of giving selected staff members an opportunity to improve from knowledge outside Venezuela. For some, it means a course in English at Queens College in New York; for others, drilling equipment maintenance courses in Texas, or office administration elsewhere.

This training broadens the general outlook, allows better understanding of the rest of the world and, in many cases, a period spent abroad gives an individual added prestige.

A graduate engineer or a medical doctor may be selected for post-graduate studies in the USA or England. A nurse may be sent to a British hospital to gain specialized experience. An exploitation engineer may spend a period in a research center in Holland. Some younger, bright staff members may be offered an opportunity to get university training in the USA or England, or to work in a Shell refinery in Europe. Condidates for this type of training abroad are recommended by their departments and carefully screened. Compañía Shell de Venezuela usually has 12 to 24 of their staff in this type of training abroad.

3. Rotation on the Job. On-the-job training consists not only of instruction given by a foreman or a section head to his workers while they are doing productive work but also includes the definite program of rotating

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through different sections of those considered promising for future promotion. Larger departments have training supervisors who arrange these programs and who check each worker's progress.

Although direct work output may suffer at a certain moment, future benefits of this system are obvious. It is already evident that at every level men are to be found better equipped for their present and future jobs. Particularly such departments as industrial relations, accounts, and materials have elaborate systems of teaching their men systematically on-the-job, to prepare them for the higher supervisor level.

Training at Departmental Level. Apart from this type of training, the company has developed an effective safety training program including lectures, demonstrations, films, and publicity. Educational and cultural work come largely under the activities of the industrial relations, and induction of new employes is mainly a function of the staff departments.

Compañía Shell de Venezuela follows the principle that training should be carried out in the departments and that training supervisors coordinate these activities. Training coordinators in Caracas, Cardon, and Maracaibo, the three main areas of operations, assist in formulating training needs, in producing training aids and in making arrangements for special courses to be established. They are in touch with local educational institutions, and they administer the scholarship program. They report on training matters within the company.

The organization is still young and fortunately flexible enough to follow the ever-increasing demand for people who are properly prepared for the jobs they are going to perform. It should be emphasized again that the success obtained with these various training programs is largely due to the particular qualities of the raw material—the Venezuelan oil worker, who is quick to learn and proud of his knowledge. And the writer and his training colleagues in the Compañía Shell de Venezuela feel it a privilege to have been able to contribute in making the Venezuelan oil workers second to none. —**The End**

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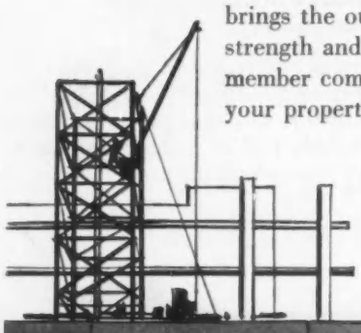

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Comfort at Kirkuk

Continued from Page 269

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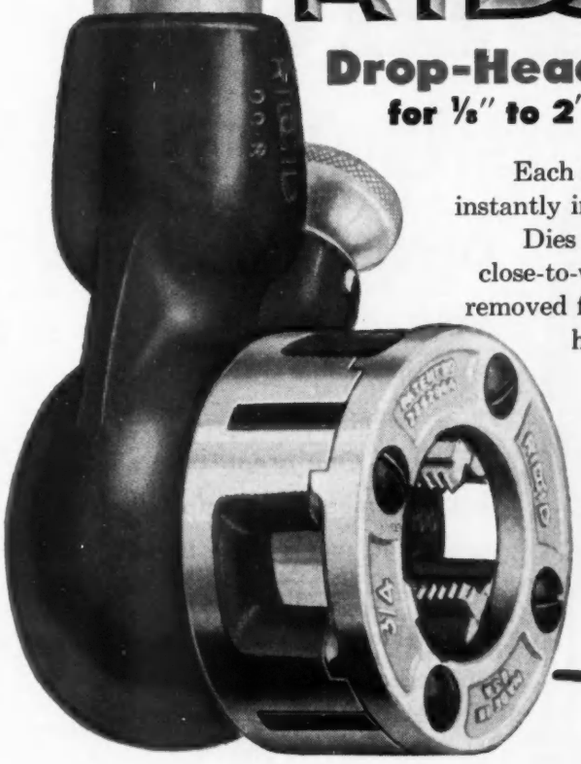

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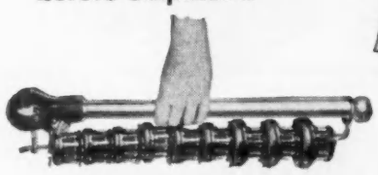

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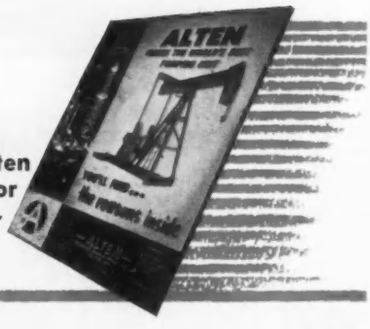

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Emerging, you pass into the shadow of the central oil administration building, then plunge into yet another big housing estate where solid, capacious bungalows squat amid the rich foliage of their encompassing gardens.

You stop at one of the larger of these houses and a young, white-clad Iraqi crosses the veranda, a broad smile on his face as though you were the very person he wanted to see. He ushers you into the cool, clean luxury of the Guest House and to your suite of rooms.

In the lounge, the crisp cool air, the friendly gentle hum of the air-conditioning plant and the beckoning easy chairs, lull you into relaxation.

Outside, there is the hot sun; the leaves of the shady trees whisper as a light breeze tugs playfully at the branches; there is the distant gurgling of water from the domestic irrigation system. You lean back comfortably and review the past crowded hour. So you're in Kirkuk.

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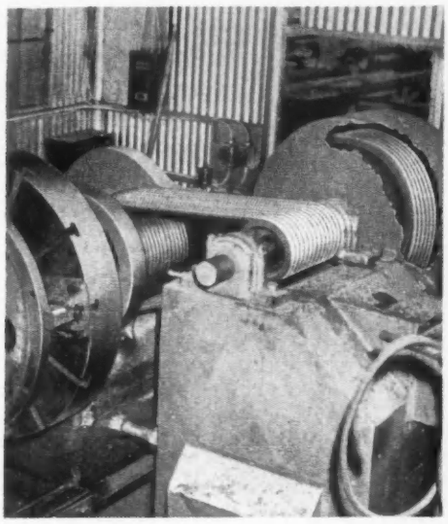

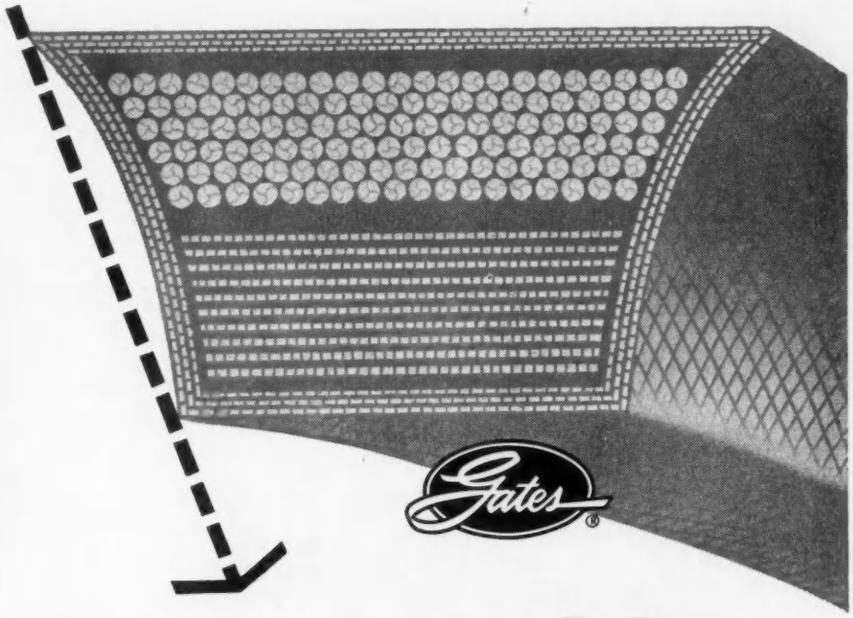

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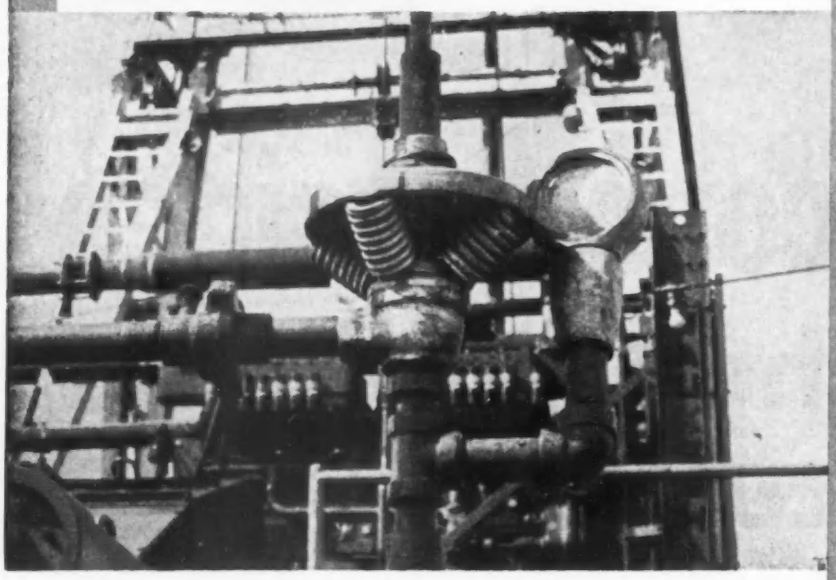

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Export Office: 74 Trinity Pl., New York, N. Y.

ducive to business. He carries a towel over his arm. He has just come, he tells you, from the swimming pool of the club where he regularly spends part of the afternoon with his wife and two children.

"You see," he explains, "we start the working day very early in the summer, and finish early—those of us who can. In this way, we avoid working in the heat of the day. It gives us the greater part of the afternoon to ourselves; some of us sleep, some play golf or tennis, others swim. For myself, I prefer the water."

You ask him about life in Kirkuk. A servant serves a round of cool drinks. The setting sun glows a deep red and casts a cozy light about the room.

Your visitor considers the matter carefully, twirling his glass idly in his hand.

"Let me tell you about myself," he begins. "I'm just about typical, I suppose. I've been here about three years and the company brought my wife and children out from England about a year ago. We've got our own bungalow—not here on this estate, but on another one five or six miles away," he waves an arm airily, "which we call Baba."

"It's newer and growing rapidly. They're roomy bungalows and set a good distance apart with gardens all round. All the main services are furnished from company sources. The furniture, crockery, and so on, are also provided by the company. For that, we pay a rent. In my bungalow we have a staff of two—a houseboy, who is also a cook, and a nanny for the children. Some people dispense with either or both, but that's up to the individual. Whatever staff we have, we pay the wages ourselves, though the company assists in finding a staff. From a domestic point of view, we are very comfortable."

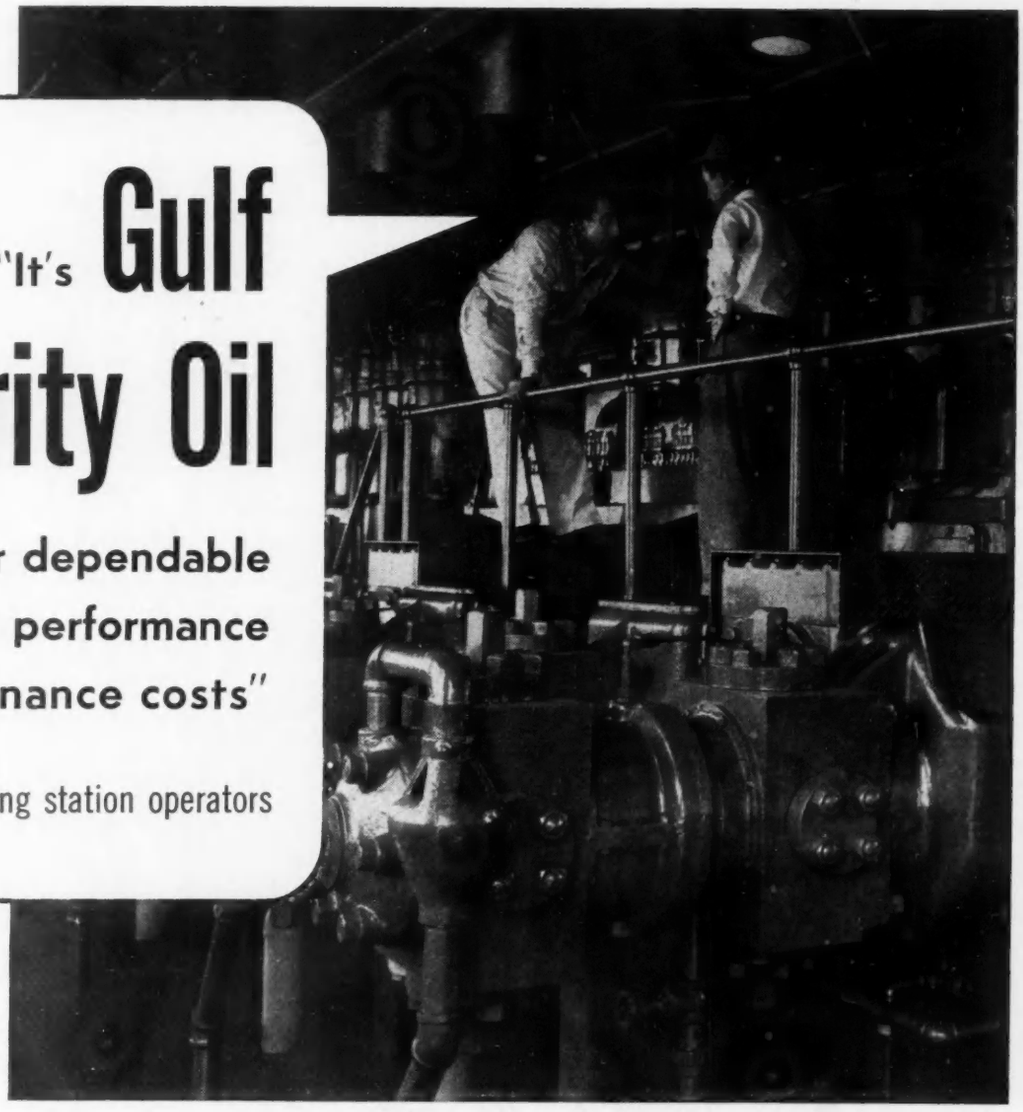
Education and health. "What about education for the youngsters?" you ask.

"Children are catered for up to the age of eight or thereabouts. For education beyond this stage we have to make our own arrangements—send

"It's **Gulf Security Oil**

for dependable gas compressor performance and low maintenance costs"

say pumping station operators



Smooth, continuous operation is a must for these units in service at a South Texas gas compressor plant. They are responsible for the steady flow of essential natural gas through pipe lines to homes and industries as far north as Detroit and New York. Gulf Security Oil provides the sure, effective protection needed for cylinders and bearings in both engines and compressors.

You can depend on Gulf Security Oil to provide the proper lubrication that is so important to vital compressor units if operating troubles are to be prevented and maintenance costs kept low.

Gulf Security Oil has a record of outstanding performance in scores of gas transmission plants. After years of operation with this quality oil, the cylinders and piston rings of both the compressors and power assemblies show negligible wear. And few carbon deposits have formed on power cylinder ports and pistons.

If you are installing new compressor units, or feel that you're not getting the most effective lubrication possible for your present units, it will certainly pay you to try Gulf Security Oil. Contact your nearest Gulf Office and have a Gulf Sales Engineer call.

Gulf Oil Corporation • Gulf Refining Company

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GULF

The finest petroleum products for your every need

our children to school in Britain, or to the Continent, or to places in the Middle East, which includes Cyprus. Most of the children, I think, go to school in England and they visit here at holiday time, particularly in the summer."

That brings another question to your mind. "And what about health? What is it like here and what medical provisions are there?"

"We have a medical service which must surely be second to none. Company doctors will visit our homes, and for treatment we have one of the finest hospitals in the Middle East, fully-equipped, fully-staffed, and capable of handling the most serious type of cases. Along with that, there is an excellent dental service, including a mobile dental clinic which covers the whole of the pipe line; it doesn't need to bother about Kirkuk Fields, of course, but it's worth mentioning.

"Strange to say, however—or naturally enough perhaps, in view of the precautions that are taken and the nature of the climate—the standard of health in Kirkuk is exceedingly high. Children thrive here, and grown-ups often say they have never felt fitter in their lives. The summer is hot, it's true, but it's a dry heat, and winters are cold; malicious insects are few and infectious diseases practically non-existent."

"Kirkuk Fields seems to cover a very big area; how do you get about the place?" you ask.

"Quite a few of us have our own transport—even if it's only a pickup; but there are regular bus services running to schedules and there are company taxis on call for local jobs."

Social life. "What about leisure? You mention a club, but what does it comprise exactly?"

"The club is the social, or community center. It has its own organization, independent of the company—though, of course, the company takes a fatherly interest in it, even to the fatherly responsibility of footing the bigger bills. You can have a drink, a game of billiards, play cards or badminton, borrow books, swim, play tennis, read magazines, or just sit and talk. There are also regular movies and dances. Apart from the club, however, there is a very fine golf course with a modern clubhouse, and there's a sports ground with a big pavilion."

"And do you take part in these activities independently, or is it all organized?" you ask.

"Both. You see, it's well-nigh impossible to list all the activities in one single breath. You can perhaps cover it best by saying that wherever your leisure interests may lie, there is something here to cater for you. And not all the activities are confined to the club—physically, at any rate. There are two other organizations I can think of—the Riding Club (horse-riding, that is) and the Automobile Club."

"From an amenity point of view you seem to be very well served. But

competition *makes it better!*

SURE, COMPETITION makes everything better. Competition made America great. Competition makes oil well cementing service better, too. On your next cementing job, call in the company that is sparking the business with its new, dynamic approach to equipment and methods.

Engineered answers to oil well cementing

BJ SERVICE, INC.

For details, see Page 249

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VICTORIOUS JARS

OF ALL THE JARS MADE IN THE USA

Acme

Produces over 85% of the Carbon Drilling Jars. Makes more than 75% of all Fishing Jars And before 1956 ACME will be producing a majority of all Jars for *Cable Tool Drillers.*

ACME ALLOY JARS are made of CHROMIUM - MOLYBDENUM NICKEL **Alloy Steel**

Which will wear longer and give less breakage than the alloy steel used by others.

ALLOY

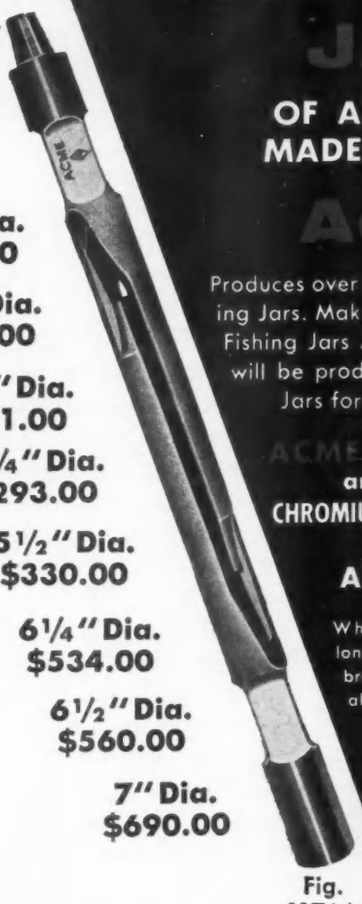

Fig. 107AA

3 1/4" Dia. $244.00

3 5/8" Dia. $244.00

4 3/8" Dia. $271.00

4 3/4" Dia. $293.00

5 1/2" Dia. $330.00

6 1/4" Dia. $534.00

6 1/2" Dia. $560.00

7" Dia. $690.00

Acme Alloy Jars have more Wearing stock than any other make.

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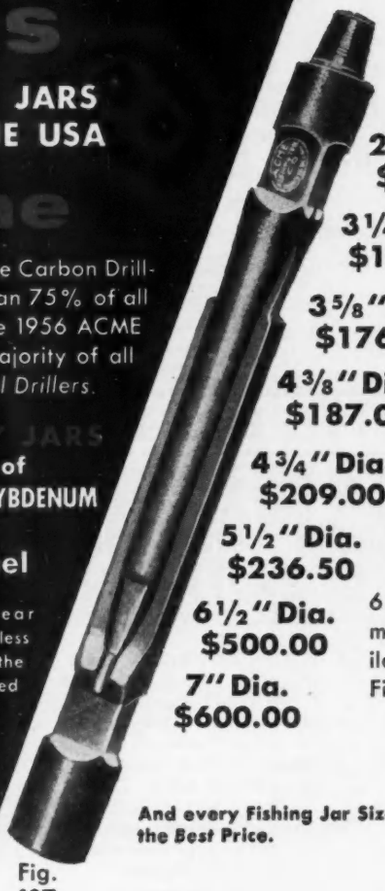

Fig. 107

2 5/8" Dia. $154.00

3 1/4" Dia. $165.00

3 5/8" Dia. $176.00

4 3/8" Dia. $187.00

4 3/4" Dia. $209.00

Every Fishing Jar size as well as every Drilling Jar size.

5 1/2" Dia. $236.50

6 1/2" Dia. $500.00

6 1/2" Dia. and larger sizes are made to heavy construction, similar to Acme Alloy Rein Type Jars. Fig. 107AA.

7" Dia. $600.00

And every Fishing Jar Size at the *Best* Price.

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With 55 years of continuous experience, Acme Carbon Jars have emerged victoriously because we have superior quality controls and production methods. Acme carbon jars in 1954 were bought by well drillers in more states, more provinces of Canada, and more countries in the world than any other make.

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what opportunities are there for work of a creative nature? Surely you people don't just sit back and let everything be done for you?"

"By no means. Take, for instance, the running of the club and all its concomitant activities. Think of all the responsibility involved. Somebody has to do the work, even if it's only pouring out the tea. All these groups cannot be left simply to run themselves; the more active you are, the more workers you need—whether it's organizers or practical helpers. But there's much more to it than that.

"There's the Ladies' Working Party, which has done an enormous amount of charitable work in addition to local commitments, and there's an amateur stage organization. All that adds up to a great deal of useful creative work. Whenever we put on something special, everything from decorations to dance music is supplied from local resources. Everybody lends a hand. We can put on shows here that would do credit to a royal palace—in fact, we've entertained royalty more than once and much of the display has been due to local voluntary effort."

The Iraqis. "And do the Iraqis share these activities?" you wonder.

"Many of them; the others have parallel facilities of their own; their own club and their own sporting amenities."

"Would you say that working conditions for them are good?"

"Very good. Their conditions, and the degree of company welfare, are right in line with dispensation in western industrialism. They are very well looked after in every sense—housing, health, feeding, protective clothing, safety, good-housekeeping. We have developed Joint Consultation, and it's working extremely well. We have our own technical training schools for apprentices, tradesmen and potential supervisors, and there are many Iraqis who are qualifying for taking responsibility in practically every sphere of industrialism. Some go to England, either under our own company scheme of training or in conjunction with the Iraq government who are pursuing technical training energetically."

"And do you get response in productivity?"

"The Iraqis are an adaptable people; they are also innately friendly. What you have to remember, though, is that for many centuries, up to very recently, Iraq has been entirely an agrarian country. Now it is experiencing an industrial revolution. Fortunately Iraqis have remarkable aptitude. But you have to walk before you can run. The wonder of it is that so much is being achieved having regard to the lack of industrial experience among the people."

"So," you add it all up, "right in the middle of this country that belongs to pre-history, we find the latest developments in the science of social economy."

Your visitor nods. "There, in brief, you have a picture of Kirkuk."

—The End

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New York, N. Y.—Max Rothenberg, 11-05 38th Ave., Long Island City
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San Francisco, Cal.—Earl H. Jones & Co., 1150 Folsom St.
Seattle, Wash.—Earl H. Jones & Co., 819 Thomas St.

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What's Happening Among . . .

WORLD OIL Men

In the U. S. to learn rotary drilling techniques, JACQUES GOHIER of of Bethune, France, is making his headquarters at the Enid Okla., plant of the George E. Failing Company, a subsidiary of Westinghouse Air Brake Company. Gohier was sent to the U. S. by C. Chartiez and Sons, drilling contractors operating in northern France.

Jacques Gohier

•

R. A. EADS has been elected vice president in charge of industrial relations for the Arabian American Oil Company. Eads, who was general manager of operations, joined Aramco in 1950. He will continue to be stationed at Aramco's headquarters in Dhahran, Saudi Arabia.

R. A. Eads

•

CARL F. VANDER CLUTE has been named general manager of the Marine department of Gulf Oil Corporation with headquarters at 17 Battery Place, New York.

Carl F. Vander Clute

Vander Clute has been assistant to Willard F. Jones, vice president and general manager who retired after more than 50 years of service with the Gulf Marine department.

Vander Clute is chairman of the council of New York State University

NEW

SPEEDY MAKE OR BREAK for those "hard-to-get-at places"!

CATAWISSA 4 Star HAMMER TYPE LUG NUT UNIONS with CATAWISSA'S EXCLUSIVE PERFECT SEAL and 3-to-1 SAFETY FACTOR

2" to 4" sizes
REGULAR OR DOUBLE-START ACME THREADS

FAST
INTERCHANGEABLE PARTS
SELF ALIGNING
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AN EFFICIENT TIME AND TOOL SAVER
for dependable, trouble-free service!

Now available in 2" to 4" sizes (inclusive), Catawissa 4-STAR LUG NUT UNIONS incorporate an exclusive combination of both lug and hexagonal shaped nuts with regular or Double-Start Acme threads for speedy make or break with either HAMMER OR WRENCH! The Catawissa Lug Nut design provides more striking surface—a straight, flat surface that eliminates the chance of a damaging, glancing hammer blow!

New Catawissa 4-STAR LUG NUT UNIONS are hot forged from solid steel bars, conforming to A. S. T. M. Spec. A-105, grade 2. Exclusive PERFECT SEAL seat design gives safe, sure, leakproof joints even with the pipe not in perfect alignment.

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TAKE THE GUESSWORK OUT OF UNION REQUIREMENTS

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GOLDEN CROWN SERVICE TO

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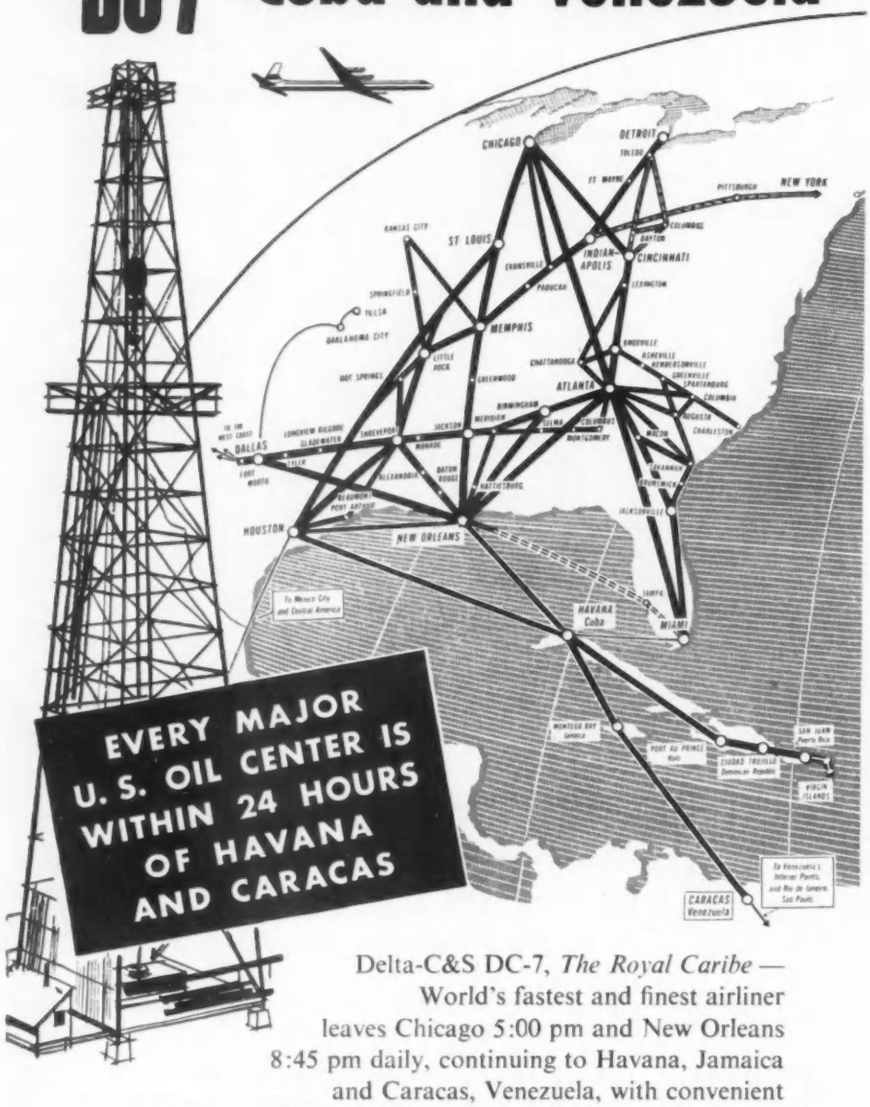

Delta-C&S DC-7, *The Royal Caribe* — World's fastest and finest airliner leaves Chicago 5:00 pm and New Orleans 8:45 pm daily, continuing to Havana, Jamaica and Caracas, Venezuela, with convenient early morning arrival offering connections to all interior Venezuelan points.

Super Convair leaves New Orleans every Mon., Thurs. and Sat. at 8:30 am for Havana, Port-au-Prince, Ciudad Trujillo and San Juan. Through-plane service from the West Coast via Delta-C&S and American Airlines interchange service to New Orleans, fast connections from all points — coordinated to speed you to booming Cuba and Venezuela.

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Maritime College. He is also a member of the board of directors and executive committee of the New York State Waterways Association, as well as a member of the Propeller Club of New York and several other marine organizations.

•

K. B. CHARLES, drilling engineer for The British Petroleum Company, who has been in the Middle East for several years has been transferred to Canada. He visited fields and installations along the Texas Gulf Coast, West Texas, the Pacific Coast, and Mid-Continent area before going to Canada.

•

Another royal honor has been given R. MEGANCK, managing director of The British Petroleum Company group in Belgium. King Baudoin appointed him a chevalier de l'Ordre de la Couronne in recognition of his 25 years of meritorious service in the oil industry. Meganck has been with The British Petroleum group for that period and has been managing director in Belgium since 1951.

R. Meganck

Last year King Baudoin appointed Meganck a member of the Cadets d'Honneur du Travail de Belgique, a group composed of leading Belgians who have rendered exceptional civic services.

•

Appointments to newly-created positions with Egyptian-American Oil Company, a subsidiary of Continental Oil Company, include:

FRED L. MACE, Denver, assistant to Conoco's Rocky Mountain region general management, appointed assistant to the general manager of Egyptian-American Oil Company.

HARVEY R. PETERS, Ponca City, a member of Conoco's accounting staff, named accounting division supervisor for Egyptian-American.

LINDSEY H. EDWARDS, Ponca City, internal auditor for Conoco, appointed budget and fiscal supervisor for Egyptian-American.

All three will make their new headquarters at Cairo. Egyptian-American

International Visitors

Guests at a recent meeting of the Los Angeles Chapter of Nomads included (left to right standing) A. Maclay Gardner of Lane-Wells Company, Brazil; Theo. S. Kopren of Santa Fe Drilling Company, Arabia; C. F. Davidson of Aramco, Saudi Arabia. Seated are A. J. Davis of B.M.P., Borneo; John Sligh of D.&E., Brazil; C. B. Welch of Santa Fe Drilling, Kuwait; and C. M. Williams of D.&E., Brazil.

---

is exploring for oil on a 50-million-acre concession in Egypt's Western Desert.

Mace joined Conoco at Ponca City in 1948 and transferred to Denver the following year. He was successively chief production clerk and industrial relations manager for the company's Rocky Mountain region before his promotion in 1953 to assistant to the regional general management at Denver.

Peters became associated with Conoco in 1947 and has held several positions in the company's accounting department at Ponca City for the past eight years.

Edwards became associated with Conoco's accounting department at Ponca City in 1951 and served two years with the company at Houston, Texas, before returning to Ponca City last year as an internal auditor.

•

JAMES WEIR, formerly with the Saskatchewan government Budget Bureau, has been appointed assistant administrator of mining lands in the Saskatchewan Department of Mineral Resources.

•

International Petroleum Company, Limited, Coral Gables, Florida, recently announced these personnel changes:

E. C. BORREGO, executive representative of IPC's interests in Colombia for the past four years, has been appointed assistant to the president. Borrego formerly was associated with Standard Oil Company (New Jersey) and its affiliates in Mexico, U. S., Venezuela, and Italy.

MILO M. BRISCO, general manager of IPC in Peru, will succeed Borrego in Colombia.

JACK ASHWORTH, assistant general manager in Peru, will succeed Briscoe in Peru.

R. W. BYERLEY, for the past three years assistant IPC economics advisor, has been transferred to Lima, Peru, where he will head the Eco-

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Tube-Kote's
TK-2
PLASTIC
LININGS
are considered the most dependable and economical protection against corrosion and paraffin!

One of Tube-Kote's many specially-designed automatic spraying units which produce smooth, uniform coatings of TK-2 plastic.

TK-2 is Tube-Kote's exclusive plastic . . . developed in Tube-Kote laboratories . . . made in Tube-Kote's own compounding department . . . applied and baked by Tube-Kote's specially designed equipment—all under the direct supervision of Tube-Kote chemists and engineers. Their special equipment permits proper pre-conditioning of metal surface . . . assures uniform application of plastics . . . affords an accurate control of baking temperatures.

Another guarantee of high quality is Tube-Kote's 16 years of experience in the development of plastics for lining oil field equipment. They know the problems involved in combating corrosion and paraffin, and they understand the characteristics and properties plastic linings must have to solve these problems. Their TK-2 has proved so superior it has been applied to more than 12,000,000 feet of oil field pipe!

Pioneers of plastic linings for oil field equipment since 1939.
Manufacturers-extruders of plastic pipe for the oil industry.

Write for New 1956 Bulletin on TK-2 Plastic Linings.

Factory-trained field engineers available for consultation in all principal oil areas.

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nomics department of IPC operations in Peru. Byerley began working for Carter Oil Company in 1936, and later was with Standard Oil Company (New Jersey).

W. H. CARTER, former head of the Economics department in Peru, has been transferred to Coral Gables as assistant economics advisor. Carter was in the Accounting department of Imperial Oil Limited in Canada from 1945 to 1948, when he joined IPC and went to Lima.

WILLIAM BARNES, formerly with Esso Standard's refinery Economics department, has joined IPC, and will be stationed in Lima as assistant chief of the company's Economics department in Peru.

•

DR. A. TEN DAM has accepted a position with Tide Water Associated Oil Company for its exploratory activities in Turkey. He was a consulting petroleum-geologist with the Petroleum Division of the Mining Research and Exploration Institute of the Turkish government at Ankara, Turkey, for the past few years.

•

JOHN R. McKAY of Calgary, Alberta, Canada, has been appointed regional supervisor in charge of the Canadian operations for Plymouth Oil Company with headquarters in Calgary. This is a new position with Plymouth Oil Company following the recent opening of its Canadian region offices in Calgary.

McKay was born in Camrose, Alberta, and was graduated from the University of Oklahoma with a B.S. degree in Petroleum Engineering in 1941. He resigned his position as production manager of Banff Oil, Ltd., to accept the new position. Prior to his association with Banff, McKay had been division petroleum engineer of British American Oil Company, Ltd., senior engineer for California Standard Oil Company, and had also been a petroleum consultant.

10,000-Foot Israel Test May Be Drilled Soon

If exploration tests justify development of their two concessions in Israel, Nadel and Gussman, independent oil producers of Tulsa, and Palestine Economic Corporation of

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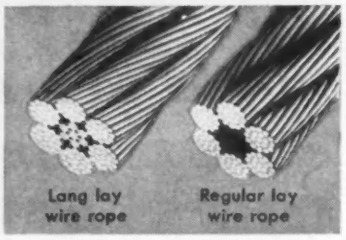
(For more data on advertised products, use Readers' Service blue cards, last page this issue.)



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Look at a length of Lang lay wire rope. Compare it with regular lay. Notice that the *wires* in Lang lay rope twist in the *same* direction as the *strands*. In regular lay rope these directions are opposite.

What does that do? It makes the exposed length of the outer wires in Lang lay rope about twice as long as in regular lay rope. It has extra bearing surface to withstand wear from scuffing, rubbing and other abrasive action. Also, because Lang lay wires and strands are laid in the same direction, the rope has greater flexibility.

What's the result? Simply this—on some types of duty, where abrasive and bending stresses are abnormal, Leschen Lang lay rope definitely lasts longer than regular lay. Replacements are fewer. Costs are lower. And, with Leschen you are assured of *higher-than-rated quality* for *longer-than-expected wire rope service.*

Can you use these benefits? To make sure, ask your Leschen man. Leschen makes all types of Red-Strand wire rope for all types of jobs, and can help select the best one for you. Perhaps you *should* use Lang lay. Talk to him soon.

Depend on Leschen's higher-than-rated quality for longer-than-expected service.

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HERCULES *Red-Strand*® WIRE ROPE
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H. K. PORTER COMPANY, INC.
St. Louis 12, Missouri
HKP

New York will drill a 10,000-foot well.

Nadel and Gussman and PEC are conducting exploration tests on the concessions which total approximately 100,000 acres. They obtained their concessions last year.

Early gravity work was done by the Weizmann Institute of Science, which determined the presence of anomalies. After Nadel and Gussman acquired their concessions, they employed a Tulsa seismic company, Geophysical Consultants, Inc., to make intensive seismic tests which confirmed the presence of a structure.

Herbert Gussman, one of the partners, said they worked out an agreement with the Israel American Oil Company, a subsidiary of Husky Oil Company of Cody, Wyo., and Baer-Stearns, investment bankers of New York, to pool some of their adjoining acreage.

Core tests were under way on the Nadel and Gussman-PEC acreage, and location has been staked for a stratigraphic hole to be drilled on top of the seismic structure. The hole will be drilled to the Miocene or Turonian-Cenomanian around 4000 feet.

Israel has no oil production. However, deep tests drilled in the country have encountered shows of gas in upper horizons, and some oil shows have been found.

Since Israel's petroleum law was adopted two years ago, licenses covering 2.5 million acres or about half of the country's total land area, have been issued by the government to eight companies or groups.

Domestic requirements of Israel amount to 20,000 barrels of products daily, with the country pouring out $50 million yearly for crude and products imported from Venezuela.

The Nadel and Gussman concessions are in the coastal plains area, primarily on the Mediterranean coast.

Bolivia Hopes to Boost Oil Yield to 15,000 bpd

Bolivia hopes to increase its crude production to 15,000 barrels daily by the end of 1955, Mario A. Montenegro, director general of petroleum for the Ministry of Mines and Petroleum

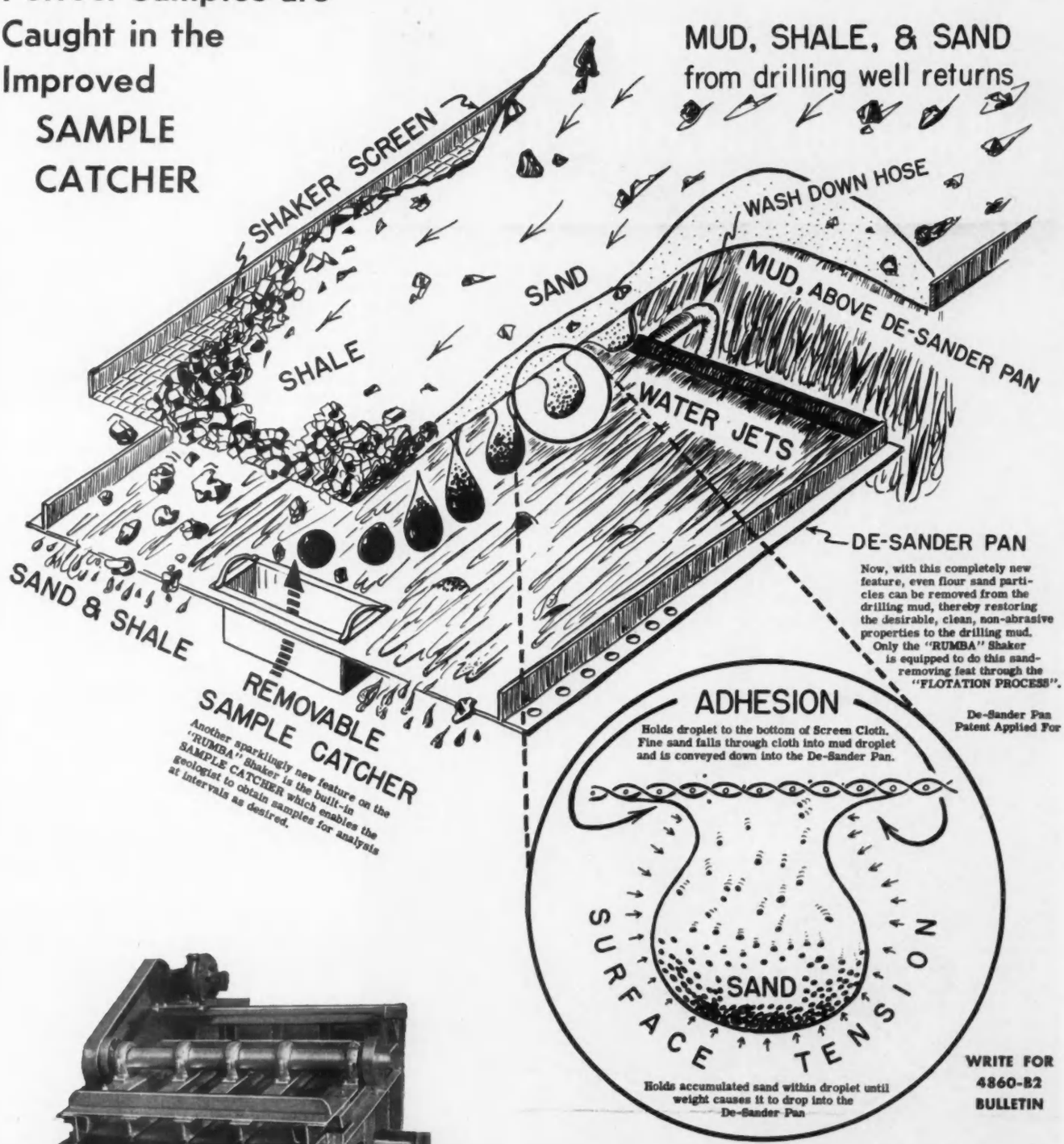
Successful Contractors have learned----

You can *DESAND* your mud with the new

"RUMBA" SHALE SHAKER and DE-SANDER

which increases pump life and reduces maintenance cost

Perfect Samples are Caught in the Improved SAMPLE CATCHER



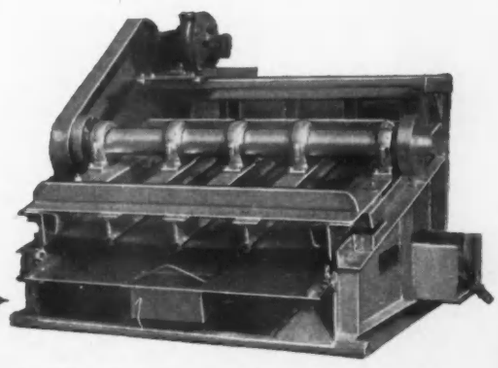
Now, with this completely new feature, even flour sand particles can be removed from the drilling mud, thereby restoring the desirable, clean, non-abrasive properties to the drilling mud. Only the "RUMBA" Shaker is equipped to do this sand-removing feat through the "FLOTATION PROCESS".

De-Sander Pan Patent Applied For

Another sparklingly new feature on the "RUMBA" Shaker is the built-in SAMPLE CATCHER which enables the geologist to obtain samples for analysis at intervals as desired.

Holds droplet to the bottom of Screen Cloth. Fine sand falls through cloth into mud droplet and is conveyed down into the De-Sander Pan.

Holds accumulated sand within droplet until weight causes it to drop into the De-Sander Pan



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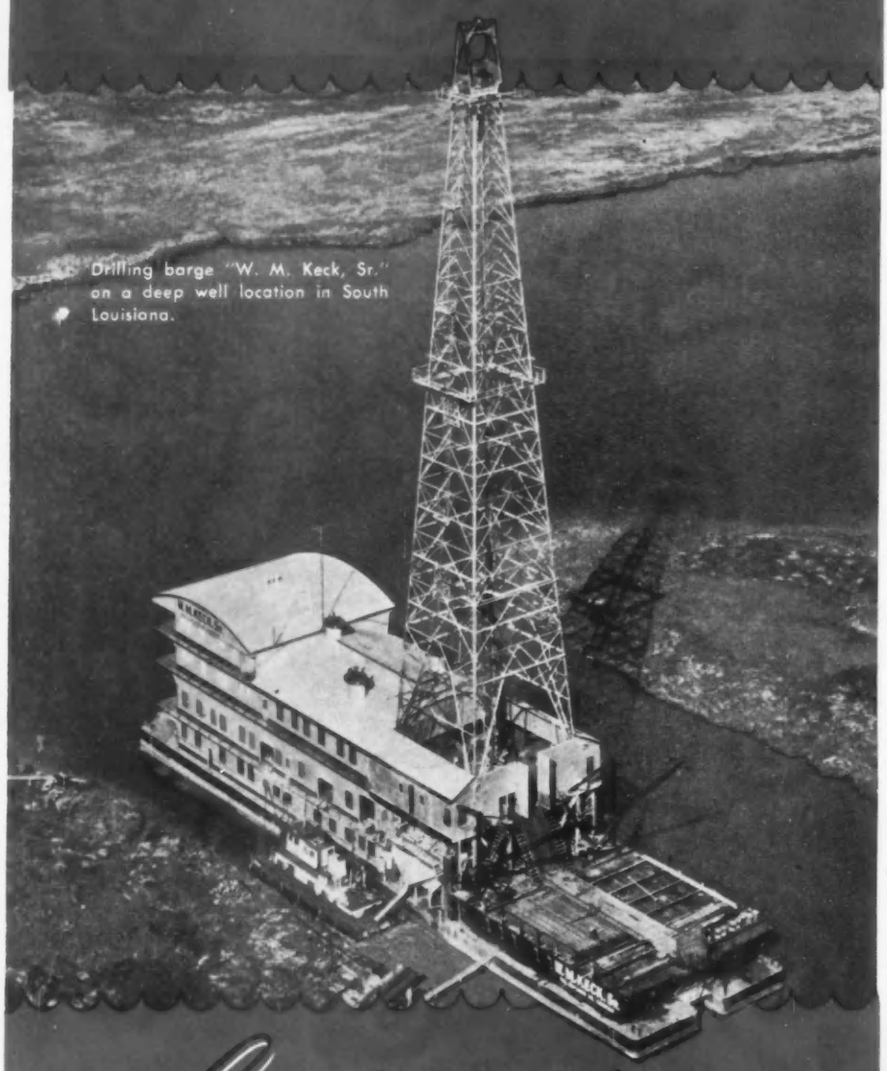

Drilling barge "W. M. Keck, Sr." on a deep well location in South Louisiana.

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for the Bolivian government said on a recent visit to the U. S. This would permit the South American republic to offer 10,000 barrels of oil daily on the international market.

According to Montenegro, Bolivia imported $9 million worth of crude and products annually up to 1953. The country became self-sufficient in 1954, and has an ambitious program outlined aimed at becoming a larger exporter at an early date.

During the past two years, Montenegro said, the Bolivian government has invested $14 million in the country's oil industry, buying equipment from the U. S. and pipe from German and Italian mills.

Bolivia has a crude production capacity of 12,000 barrels daily, consumes more than 5000 barrels daily, exports 2700 barrels of crude a day to Argentina, and exports gasoline to Chile. Two principal refineries located at Sucre and Cochabama have combined capacity of 11,000 barrels daily.

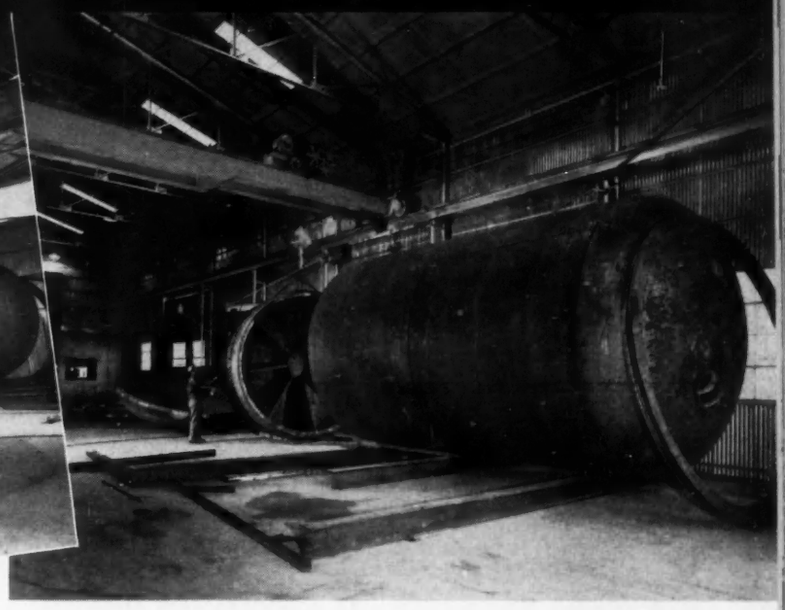
YPFB, the governmental agency which operates Bolivia's oil fields, is adding three drilling rigs. Glenn McCarthy of Houston, Texas, who has a concession in Bolivia of 900,000 acres, is bringing in a heavier rig to help develop his concession. His second well is producing 300 barrels of oil daily.

Williams Brothers, pipe line contractors of Tulsa, has completed two projects totaling 560 miles of pipe lines in Bolivia, and is starting a new project 220 miles long. The firm's most recent completion was a 160-mile 6-inch crude line from the Camiri oil fields to the Argentina border.

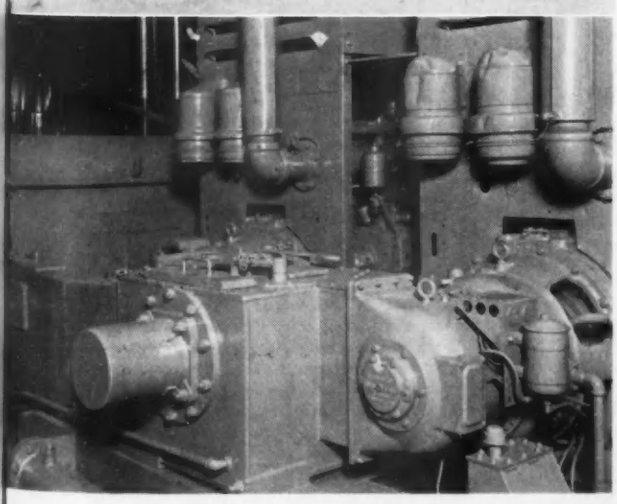
The Tulsa-based company has been awarded a contract for a new 220-mile pipe line to be built in four stages. The first stage will be a 6-inch products line from the refinery at Cochabama to Oruro and La Paz, the capital. Later, when production warrants it, a 10-inch and 8-inch line will tap the products line at Sicasica and run to Arica, Chile, on the Pacific Coast. This line will be used to transport crude to the coast for export.

The fourth stage will be a 12-inch line looping the existing crude system from Camiri oil fields to Sucre.

SPECIALIZED OFF-SHORE EQUIPMENT



A hydraulic lift recently fabricated at the shops of Joe Stine, Inc., is shown during assembly. This particular unit has a cylinder O.D. of 12 feet, and a 100 ft. stroke.



A typical compound of engines and pumps rigged up, skid mounted and engineered at Joe Stine, Inc.

HYDRAULIC JACKS

The construction of hydraulic equipment for use in off-shore operations is a specialty of Joe Stine, Inc. Hydraulic lift mechanisms, spudding devices, barge stabilizers, and similar assemblies are designed and constructed to order.

Virtually any size equipment of this type can be constructed by Joe Stine, Inc., from a hydraulic jack of very small size to a lifting device of several feet in diameter.

The cost of such equipment is relatively low at Joe Stine, Inc., due to construction economies made possible by the use of the Bowen-ITCO Seal Ring Assembly.

High pressure cylinders can also be provided for jacks utilizing up to 10,000 psi. and above.

COMPOUND

Off-shore equipment fabricating and repair from draw-works, pumps, and boiler feed units to mud conveyors, are regular shop jobs at Joe Stine, Inc. Your strictest requirements in specialized equipment will be adhered to in our shops, and expert supervision will assure complete satisfaction.

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What's Happening

AMONG MEN IN THE INDUSTRY

Myron C. Kiess

Stefan Von Croy

S. A. Shannon

Bert C. Timm

N. C. Simpson

L. H. Moore

Sunray Mid-Continent Oil Company announces the following changes in exploration department personnel: **Myron C. Kiess,** chief geologist for Mid-Continent Petroleum Corporation before the merger of Sunray and Mid-Continent, has been named geological manager. **Stefan Von Croy,** formerly division geophysicist for Sunray, has been appointed chief geophysicist. New assistant chief geologists are **Sherril A. Shannon** and **Bert C. Timm,** both former division geologists for Sunray. Shannon, in addition to serving as administrator in the Exploration department, will retain immediate supervision over exploration operations in southeast Texas, south Louisiana and the southeastern states.

•

Edward Heron McCollough, executive vice president of **Amerada Petroleum Corporation,** recently was elected president of the corporation at a meeting of the board of directors in New York. **Alfred Jacobsen,** president of the company since 1929, was elevated to the position of chairman of the board and will continue as chief executive officer. **B. B. Weatherby,** vice president of Amerada, was selected senior vice president. McCollough's headquarters will remain in Tulsa.

•

H. Carroll Talley, Jr., made staff geophysicist in headquarters Exploration department of **Sohio Petroleum Company,** will assist **Roy Bennett,** chief geophysicist. He succeeds **John Bemrose,** staff geophysicist, who will handle special projects and research. **Cyril B. Smith** has rejoined Sohio as district geophysicist succeeding Talley. In the Production Accounting division, **Coye A. Ramsy,** staff assistant has been transferred to Billings, Mont., as division financial assistant. He succeeds **Charles F. Andrews,** transferred to Production department headquarters in Oklahoma City to assist **John T. Cooke.**

•

H. C. Kauffmann, Jr., has been appointed production manager for **The Carter Oil Company's** Southern division. With Carter nine years, he began as a roustabout in Seminole, Okla. He held production and engineering posts in Kansas, Oklahoma, Mississippi, Colorado and Arkansas before transferring to Shreveport early this year as production staff assistant. **Willard D. Maxwell,** district superintendent at Great Bend, Kansas, has been named to succeed Kauffmann as production staff assistant. A veteran of 30 years with Carter, he has worked as roustabout, pumper, gang pusher, field clerk, foreman and district superintendent. **Hugh H. Goerner,** assistant district superintendent at Magnolia, Ark., will succeed Maxwell as district superintendent at Great Bend. He was employed as an engineer in 1947 and has served in various capacities of engineering work including district engineer at Jackson, Miss.

•

Delta Drilling Company announces that **T. N. Singley** has been promoted from driller to toolpusher. Now in Tyler, Texas, he will be working on a rig in the southeastern part of Henderson County.

•

E. C. (Ned) Broun, Jr., has joined **Henderson Drilling Corporation** of Houston as assistant manager. Formerly a petroleum engineer with Humble Oil & Refining Company and chief petroleum engineer, Herman & George R. Brown, Oil & Gas division, Broun is a petroleum engineering graduate of Texas A. & M. College and a registered professional engineer in Texas. **Clive Runnells, Jr.,** has been named a director of the drilling firm.

E. C. Broun

•

H. L. Olson, Angleton, Texas, district superintendent of **Stanolind Oil and Gas Company,** was transferred recently to the company's Calgary, Alberta, Canada, office as assistant division production superintendent. **J. O. Fair,** Stanolind district superintendent at Lake Charles, La., was transferred to Angleton to succeed Olson, and **M. B. Gordy,** field superintendent of Stanolind's Anse La Butte, La., area, was promoted to district superintendent to fill the position left vacant by Fair's transfer. Olson was named Angleton district superintendent in 1954. He was transferred to the Gulf Coast division from Ellinwood, Kansas. Fair joined Stanolind at McPherson, Kansas, in 1936. He was named district superintendent at Lake Charles in 1953. Gordy joined the company as a roustabout in 1936.

N. C. Simpson, Gulf Oil Corporation's production manager for the Houston division, was transferred September 1 to the Pittsburgh general offices as operations coordinator for the Western Hemisphere. **L. H. Moore** will succeed him as division production manager at Houston, and **W. A. Shellshear** will succeed Moore as assistant division production manager. Simpsor. has been with Gulf since 1933, serving as production engineer, district and zone petroleum engineer prior to being named assistant superintendent of production for the Fort Worth district in 1948. In 1953 he was made production manager in Houston. Moore joined the company in 1922 and was active in the development of north Louisiana, Mississippi, Alabama and Florida fields. His new assignment covers the Gulf Coast of Texas, East Texas, Louisiana, Arkansas, Mississippi, Alabama and Florida. Shellshear joined Gulf in 1933 as chemist and laboratory assistant.

•

Raymond W. Snyder has been appointed divisional geologist for the Central division of **Tide Water Associated Oil Company** with headquarters in Tulsa. He has served continuously in the exploration branch of the oil industry since 1937, working in the Illinois Basin area, Kentucky, Kansas, and in the West Texas-New Mexico area.

•

Lowell N. Applegate has been named assistant vice president in charge of production for **Falcon Seaboard Drilling Company.** With the Production department of Phillips Petroleum Company for seven years, he has been assistant reservoir engineer for the Gulf Coast area since 1952.

•

Forrest N. Baughman has been elected secretary of **Envoy Petroleum Company** of Long Beach, Calif. He was formerly head of the firm's Accounting department.

•

C. J. Long has been named district geophysicist of **Stanolind Oil and Gas Company's** Midland, Texas, district. With Stanolind since 1937, Long has served as seismogram interpreter, party chief and district geophysicist of the Roswell, N. M., district. Replacing him at Roswell is **J. W. Fishback** who has been with the company since 1936, working as assistant party chief, party chief, gravity meter supervisor and field seismograph supervisor.

Carl B. King Drilling Company selected **Rand Larson** as area superintendent for the Gulf Coast of Texas and Louisiana. Active in the oil industry on the Gulf Coast for 29 years, Larson will head the new office of King Drilling in Lafayette, La. **H. G. Gill** and **Bert J. Crippen** were named rig superintendents. Larson began work in the oil industry in Louisiana in 1926. Prior to joining King Drilling, he was with Kerr-McGee, working principally with offshore drilling operations.

Rand Larson

•

Jesse L. George, Jr., recently joined **P. R. Rutherford** in Houston as general manager of the Land and Exploration department. He formerly was division geologist for Sohio Petroleum Company in the Gulf Coast division.

•

Henry H. Hewetson, who joined the **Standard Oil Company (New Jersey)** organization 31 years ago as a student engineer, recently was elected a vice president of the company by the board of directors. A director since 1950, he has served with Jersey Standard affiliates as an engineer and as a manufacturing and marketing executive in Canada, South America, Europe and the U. S. Hewetson was elected a director and vice president of Imperial Oil Limited in 1940, president in 1945 and chairman of the board four years later.

Henry H. Hewetson

•

Stanley G. Bendorf, formerly with Cities Service Gas Company and Phillips Petroleum Company, has resigned from the firm of DeGolyer and MacNaughton of Dallas to open offices as an independent petroleum consultant. His offices will be in the Fidelity Union Life building. He had been a consultant in preparation of engineering and valuation reports of oil and gas properties with the Dallas firm.

•

Marion W. Boyer, a member of the board of directors of **Standard Oil Company (New Jersey)**, has been elected to the board of directors of the Commerce and Industry Association of New York, Inc. Boyer has been with the Jersey Standard organization since 1927 when he started as a chemical engineer in the Esso Laboratories at Baton Rouge. He was executive vice president of Esso Standard prior to his election to the board of Jersey Standard.

•

Roy M. Mays has been named manager of exploration for **Continental Oil Company's** Rocky Mountain region, and **Robert E. White** has been named assistant to the general management. Mays, formerly regional land superintendent, and White, former regional chief production clerk, will continue to make their headquarters in Denver. Mays joined Conoco in 1951 as regional land superintendent after having served with the land department of another oil company and with the Federal Bureau of Investigation in Washington, D. C. White joined the company in 1949 and was made chief production clerk for the Rocky Mountain region in 1951. **C. B. Smith, Jr.**, has been promoted to regional geophysicist succeeding C. K. Shepherd recently appointed exploration manager of Egyptian-American Oil Company, a Conoco subsidiary in Cairo. Smith was formerly assistant regional geophysicist. In Conoco's Southern Region Production Department, **Otis Cooney**, division production superintendent at San Antonio, was named assistant manager in Houston. Cooney joined Conoco in 1939 and held several positions in the Production department in Louisiana before his promotion in 1943 to district superintendent at Ville Platte, La. He has been division production superintendent at San Antonio since 1945.

•

Emil Kluth, executive vice president of **Pacific Western Oil Corporation**, has announced his retirement from active duty after almost 40 years with enterprises controlled by the Getty family. He will continue as a vice president and director in an advisory capacity. **George F. Getty II**, son of J. Paul Getty, president of Pacific Western, has been elected executive vice president. He is presently a vice president of Spartan Aircraft Company and a director of Pacific Western, Mission Cor-

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Here is a high molybdenum silicon alloy steel drilling bit that will cut its way through the hardest formations faster, at less cost per foot, and with fewer dressings, than the conventional carbon steel bit used in ordinary drilling practice. The SPANG MOLLOY BIT is a *special* alloy bit, completely heat treated, with higher strength in the blade section and greater pin strength. Because of its deep penetrating hardness, it resists abrasion and battering under the severest drilling conditions. Its use is recommended where ordinary bits are ineffective.

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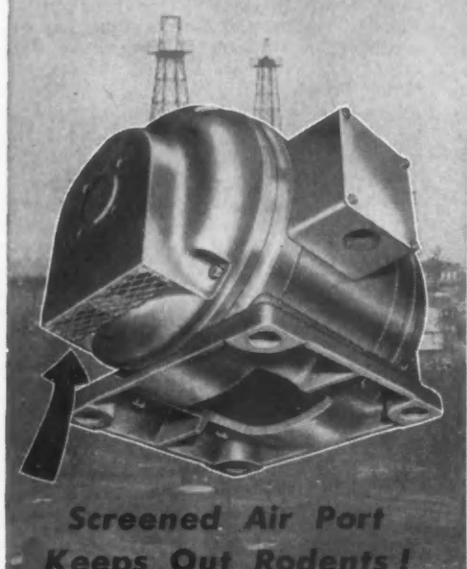

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poration and Skelly Oil Company. Kluth was employed by the late George F. Getty in 1916 and was recognized as one of the first petroleum geologists active in American oil explorations. He went to Los Angeles in 1923 and was prominent in successful oil discoveries in the San Joaquin Valley in 1926, the Getty Pool in New Mexico in 1927 and others.

•

H. F. Patterson has been named division geophysical supervisor for **Stanolind Oil and Gas Company's** Texas-Louisiana Gulf Coast division. He replaces **K. C. Thompson** who has been transferred to the Central division office in Oklahoma City. Employed by Stanolind as a computer in 1946, Patterson served as field seismograph supervisor from 1949 to 1954 when he was named district geophysicist at Midland.

•

Milton C. Hoffman, for many years associated with Stanolind Oil and Gas Company, recently was elected a vice president of Continental Illinois National Bank and Trust Company of Chicago. He will be active in oil and gas financing. After serving with Midwest Refining Company and Montana-Dakota Utilities Company, Hoffman joined Stanolind in 1931 where he held positions of gas engineer, division engineer, chief production enginer, general superintendent and Canadian division superintendent. He was also vice president and director of Standard's Pan-Am Southern Corporation.

•

Pan American Production Company announces the following staff changes in the south Louisiana exploration organization headquartered in Lafayette: **Kenneth R. Johnson**, geologist, has been promoted to senior geologist; **Ward A. Whitehorne**, associate geologist, and **Hamilton C. Perkins**, junior geologist, have been promoted to geologist, while **Coerte A. Voorhies**, junior geologist, has been promoted to associate geologist. **John W. Bell**, associate geophysicist, of the Houston office, has been promoted to geophysicist and transferred to Lafayette. **Charles W. Pirkey**, junior geologist, previously in Pan American's Shreveport office, and **Richard H. Hewitt**, associate geologist, Houston, have been transferred to Lafayette.

•

Joseph L. Seger, executive vice president of Carter Oil Company, has been elected to the board of directors of **Esso Research and Engineering Company.** Esso Research also announced the election of **Stanley C. Hope**, president of Esso Standard Oil Company, and **Cecil L. Burrill**, chief economist of Standard Oil Company (New Jersey) to the executive committee. They are also on the Esso Research board. All companies are Jersey Standard affiliates.

Joseph L. Seger

Seger is a veteran of 22 years with Carter and other affiliates of Standard Oil Company (New Jersey). He became president of Interstate Oil Pipe Line Company in 1951, returning to Carter in 1954 as vice president and director. He later became executive vice president.

William M. Barnhart

F. T. Glasscock

F. T. Glasscock, recently named vice president of **Pennant Drilling, Ltd.,** Calgary, affiliate of Signal Drilling Company, had been Canadian manager of operations since Pennant's organization in 1952. **W. A. Patterson,** formerly drilling engineer for Signal at Casper, Wyo., will join Pennant's staff at Calgary as drilling engineer. Formerly with Phillips Petroleum Company and Lakota Petroleum Corporation, he joined Signal in 1954. **William M. Barnhart,** who will replace Patterson as drilling engineer at Casper, formerly was with Phillips, Big Chief Drilling Company and Great Western Drilling Company.

W. A. Patterson

•

James B. Gibbs has been promoted to Kansas district production superintendent for **Lion Oil Company** at its Pratt, Kansas, production office. Gibbs, who joined Lion in 1952, was district petroleum engineer at the time of his recent promotion.

•

Dr. Don B. Gould, formerly chairman of the Geology department at Colorado College, is now with **Geophoto Services** as an administrative geologist.

•

Allen Ehlers, now chief geologist for **American Trading and Production Corporation** in Midland, formerly was consulting geologist in Midland and West Texas-New Mexico district geologist for Skelly Oil Company.

•

E. J. Coel

D. D. Feldman Oil & Gas has announced the appointment of **E. J. Coel** as manager of domestic operations. Coel was affiliated with the El Paso Natural Gas Company and Western Natural Gas Company 26 years, resigning as vice president and chief geologist to join Feldman. As manager of domestic operation he will supervise and coordinate the Oil Industry Relations, Production, Waterflood, Legal and Land and Exploration departments.

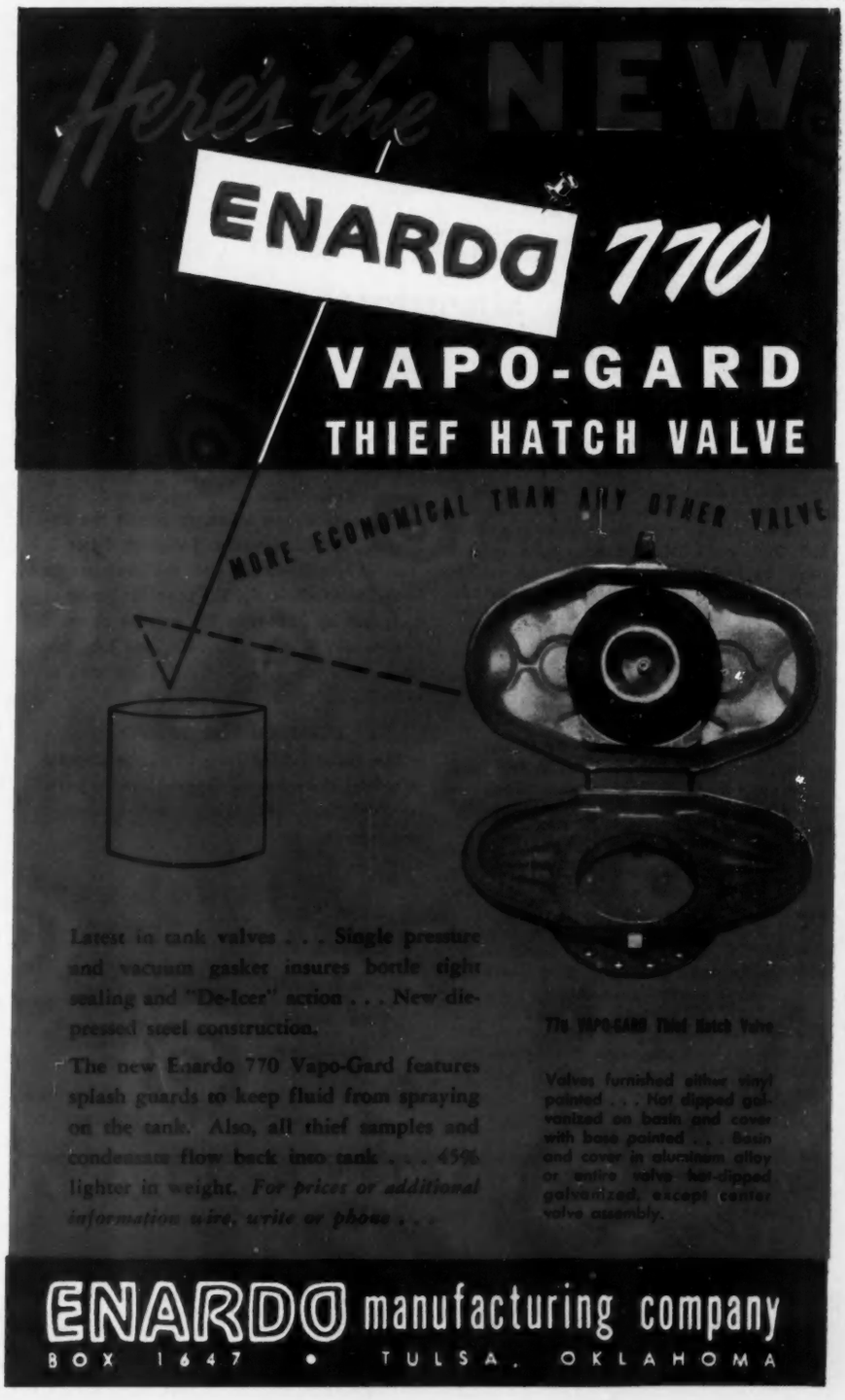
Phil H. Garrison, named division geophysical supervisor for **Stanolind Oil and Gas Company's** Canadian division, will coordinate Stanolind's geophysical prospecting program in Canada. He replaces **W. A. Matthews** who is being transferred to the general offices in Tulsa. A veteran of 16 years' experience in Stanolind seismograph operations, Garrison has served in three of the company's four operating divisions in the U. S. He was employed as a recording truck helper in 1939, and was made division geophysical supervisor in the Central division office in Oklahoma City in 1954.

•

Gibraltar Oil Corporation has announced the election of **Harry J. Russell** as vice president and his appointment as chief geologist of the company. A geological consultant in Midland for six years, he was formerly district geologist for Gulf Oil Corporation in Hobbs, N. M., and for the American Trading and Production Company in Virginia, Kentucky and Midland. Russell will head the district office being established by Gibraltar in Midland.

•

Keith L. Rathbun, regional geologist for **Continental Oil Company,** has been promoted to manager of exploration for Conoco's western region, succeeding **R. M. Barnes** who was promoted to senior consultant. Rathbun has been associated with Conoco's geological activities since 1936 when he joined the company at Ponca City, Okla. He served as assistant manager of the geological section prior to transferring to Los Angeles as regional geologist in 1946, and was promoted to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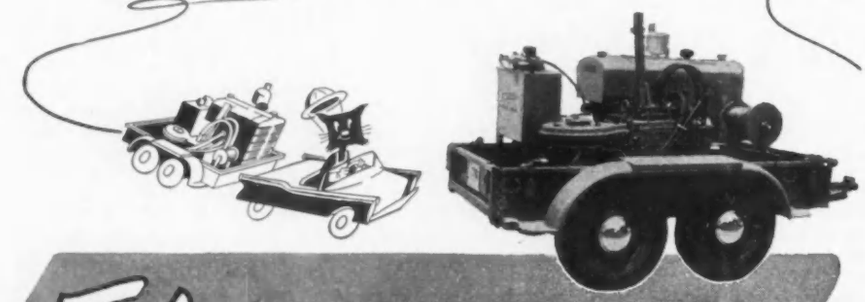
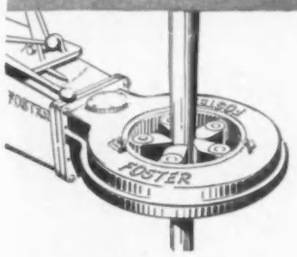


Foster TRAILER MOUNTED HYDRAULIC
TUBING TONG



FAST . . . Stays on pipe string for the entire trip!

7 seconds to break out tubing joint!

5 seconds to make up joint!

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One of the most outstanding features of the Foster Tubing Tong is that a fixed tightness can be made on every joint. If the operator desires the pipe made up with 500, 700, or 1,000 foot pounds, a special valve on the hydraulic line can be set so that every joint in the string will be made up to that tightness, no more nor less. Most tubing trouble is caused by improper tightening. This is entirely eliminated by the Foster Tubing Tong.

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The Foster Tubing Tong has a low speed of 25 RPM and a torque of 4,000 foot pounds and a high speed of 100 RPM and a torque of 1,300 foot pounds. The low speed would be seldom, if ever, needed except to break out the joint. By means of a double multiple disc friction clutch the operator is able to move instantly from low speed to high speed without cutting of the power.

The Foster Tubing Tong is a compact assembly of rugged, clean cut parts, assembled with such simplicity that years of trouble-free operation are assured.

The dogs are specially designed to grip any diameter tubing from 2⅜" OD to 3½" OD, without changing dogs. Tubing marking is reduced to a minimum. Inserts may be turned over for double life.

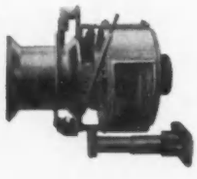
ELIMINATES FATIGUING LABOR

The Foster Tubing Tong is counterbalanced when installed, and is moved up and down with practically no effort, to permit the unlatching of the elevators. Fatiguing labor is completely eliminated, and the crew works faster, more efficiently. The operator increases his profit by increasing the amount of work a crew can do in a day. On one job, five hours were saved, over previous methods, in pulling 13,000 feet of tubing.

DESIGNED FOR SAFETY

The Foster Tubing Tong offers the ultimate in safety. There are no exposed moving parts in which the crew might become entangled and injured.

DOES YOUR SERVICE RIG HAVE A FOSTER TINY MASTER CATHEAD?



Foster CATHEAD COMPANY
P. O. BOX 1351 — 2101 GRANT ST. — WICHITA FALLS, TEXAS — PHONE 2-8653

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Peck Sales & Service ..... Houston, Texas
Tillery & Parks ..... Odessa, Texas
Garlick Sales & Service .. Oklahoma City, Oklahoma
Texas Warehouse Service .... Corpus Christi, Texas
R. D. Cloninger ..... Lafayette, Louisiana
L. W. Mauck ..... Great Bend, Kansas
W. O. Nelson ..... Farmington, New Mexico
Coastal Engineering Co. .... Bakersfield, California
Moore Specialty Company ..... Casper, Wyoming
Rotary Sales & Service Ltd. Edmonton, Alberta, Canada
Northern Well Equipment Co. Tioga, North Dakota
Longley Y Cia Srl ..... Buenos Aires, Argentina
Joe Perry ..... Salem, Illinois

regional exploration manager in 1950. **Richard B. Haines,** who has been promoted from assistant regional geologist to succeed Rathbun, joined Conoco in 1937 as geologist at Los Angeles, and later served as division geologist at Ventura before being promoted in 1952.

•

Dr. Frederic H. Lahee, one of the few men ever presented the American Association of Petroleum Geologists' Sidney Power Memorial Medal, has retired from active duty with **Sun Oil Company** after 37 years. Chief geologist at Dallas 27 years, he has been geological and research counselor to the Production department since 1947. As college professor, author, administrator, counselor and pioneer in the gathering and use of reserve and exploration data, he has become one of the best known figures in the field of petroleum geology. In 1953 the AAPG selected him as the seventh man ever to receive its highest award, the Powers Medal.

Frederic H. Lahee

•

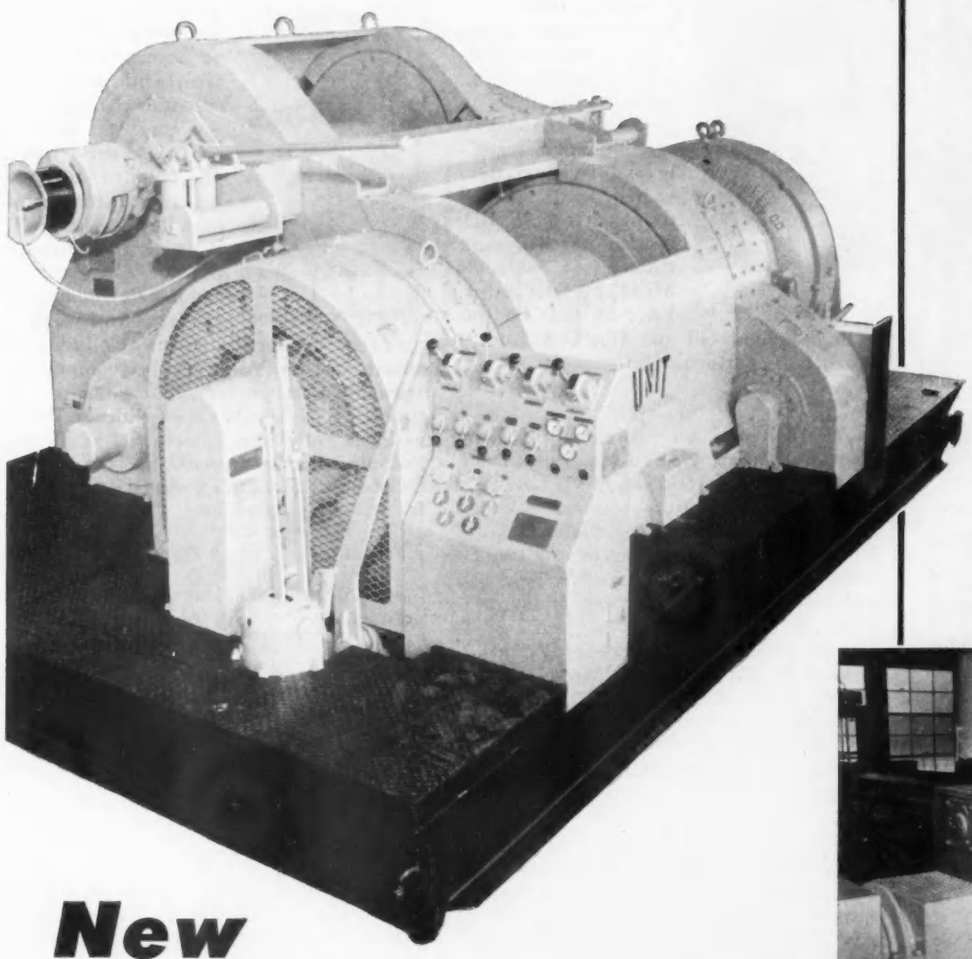
C. W. Stephens, formerly division petroleum engineer in **The Ohio Oil Company's** Los Angeles division, has been appointed senior petroleum engineer and will be assigned special duties by the division manager. **W. B. Emery II,** petroleum engineer at Bakersfield, Calif., has been named Los Angeles division petroleum engineer succeeding Stephens. A veteran of more than 27 years' geologic and petroleum engineering experience in California oil fields, Stephens joined Ohio Oil in 1929. He has served as Los Angeles division engineer since 1941. Employed as a petroleum engineer in 1948, Emery was transferred to Sidney, Neb., in 1950 and to Bakersfield in 1953.

•

Harold L. Curtis has been appointed to the newly-created post of vice president in charge of public relations for **Shell Oil Company.** He now heads a department headquartered in New York, with public relations representatives in Shell offices throughout the U. S. Curtis joined Shell in 1923 as a service station attendant. He was made manager of the advertising department in 1938 and held that position until 1943 when he became assistant to the president with responsibility for coordinating company advertising, personnel and public relations activities. He has devoted full time to public relations since 1947.

•

C. E. Cole has been named manager, Exploration division, and **L. A. Braly,** appointed superintendent, Land department, by **Arkansas Fuel Oil Corporation.** Cole, who has served as chief geologist since 1953, succeeds the late E. L. Caster. Cole also will continue to serve as chief geologist of the company. Braly is moving to Shreveport from Fort Worth where he was Southwestern division land man for the Cities Service Company (Del.).



7 BASIC BENEFITS

- **HUD reduces impact shocks up to 70%, on both driving and driven equipment.**
- **Permits full use of peak engine torque over an extended operating range.**
- **Disconnect feature eliminates need for engine compound clutches.**
- **Extends range of available speeds and pressures on mud pumps.**
- **Prevents engine stalling or lugging under load . . . extends engine life as well as lives of chains, clutches, sprockets and other running parts.**
- **Allows rig to be eased into load without strain or shock . . . heavy loads are pulled even in sticky formations without lugging the engine.**
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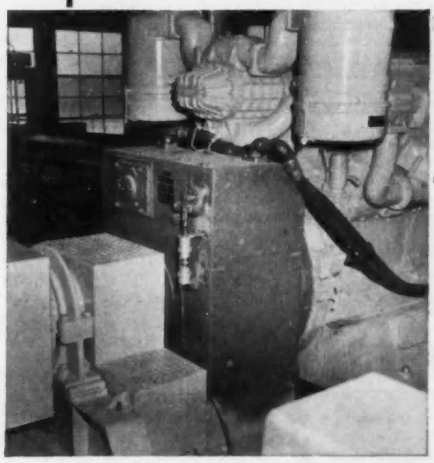

New
UNIT U-1220
uses 3 Twin Disc HUD Fluid Couplings . . .
for faster drilling, less downtime!

Pictured above is the new Unit U-1220, which is owned and operated by Loffland Bros. Drilling Co., who will use it on an offshore drilling platform. One of the largest in existence, this rig is designed for offshore and deep well drilling—with special attention given to corrosion problems encountered in this type operation.

The U-1220 is powered by 3 Caterpillar D-397 engines with 3 Twin Disc 27" Model HUD Disconnecting Fluid Power Take-Offs—and is driven by a Mid-Continent 3AE swinging drive.

The HUD Fluid Couplings provide increased drilling rate and speed ranges — more effective work from compound — unmatched ease of control over rotary, drawworks and pumps. They allow drum clutch to be engaged with brakes set, while engines can be gradually accelerated with release of drum brakes. When fishing, the precise control of speeds and loads provide improved performance.

Equip *your* rigs—present and future—with Twin Disc HUD Disconnecting Fluid Power Take-Offs, and make hole faster, easier — *at less cost per foot.*

For complete information, write today for Bulletin 506, from Twin Disc Clutch Company, Hydraulic Division, Rockford, Illinois.

Model HUD (inset above) is available in sizes 21" and 27" to handle 100 to 850 hp engines. Operates with either cooling radiator or heat exchanger. Incorporates shortened oil sump to fit rig design.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

TWIN DISC
Fluid Couplings

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

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Rainbo Service Co. ..... ME 4-2131, ME 2-2024
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Shut Down Pumping Equipment *Automatically*

WHEN: Tank is pumped out. Line breaks or leaks. Lines "paraffin up" or remote valves are closed.

REGULAR—45 Series

For distributor, magneto or dual magneto engines.

MURPHY Safety Switches provide accurate gauge and safety protection in ONE low-cost instrument.

E-45 Series

Same accurate gauge and safety protection for electric motor powered equipment

Sold by Engine Dealers and Supply Stores
Write for Information

FRANK W. MURPHY *Manufacturer*
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BRANCH: LOS ANGELES 41, CALIFORNIA

W. C. (Dick) Palmer, division manager for Ashland Oil & Refining Company, Inc., at Midland, Texas, has resigned to join the **Crow Oil Corporation** as division manager of the newly-created Midland division office. Crow, with offices in New York and Dallas, was organized recently and is engaged in exploration for and production of oil. Palmer was division manager of Ashland's Midland division. Prior to that he was with Stanolind Oil and Gas Company in the Land department.

W. C. Palmer

•

Jack W. Roach, vice president of **Deep Rock Oil Company**, also has been named assistant to the president, F. C. Love. He will continue to maintain his office in the Kerr-McGee building at Oklahoma City. In his new capacity, Roach will coordinate activities of Deep Rock's Research and Development department, and, in addition, will be in charge of special projects assigned from the president's office. **Robert M. Chesney**, vice president in charge of the Cushing refinery, also has been placed in charge of Deep Rock's Wynnewood plant. He is moving from Cushing to Oklahoma City where he will coordinate operations of both refineries.

•

A. E. Hall, with **Phillips Petroleum Company** at Bartlesville, has been employed as special projects engineer and will work in a staff capacity reporting to the chief engineer.

Standard-Vacuum Oil Company has named **Harry A. Gibbon** to the newly-created post of producing coordinator at the New York headquarters office. Gibbon will coordinate all of Stanvac's exploration and production activities throughout the Eastern Hemisphere. **Albert Wright, Jr.**, former assistant general manager of Standard - Vacuum Petroleum Maatschappij (SVPM), the company's Indonesian affiliate, and a former coordinator forStanvac's Indonesia affairs at New York, has been appointed assistant to the producing coordinator. For two years, Wright has been with the International Petroleum Company, Ltd. Before his appointment as producing coordinator, Gibbon was Stanvac's regional coordinator for southeast Asia.

Harry A. Gibbon

•

Maynard H. (Jack) Steig, appointed vice president in charge of exploration for **Lloyd H. Smith, Inc.**, of Houston, was formerly exploration manager of the Southeast region for Phillips Petroleum Company. He joined Phillips in 1938 after serving with the Mexican Gulf Oil Company, Houston Oil Company and Shell Oil Company.

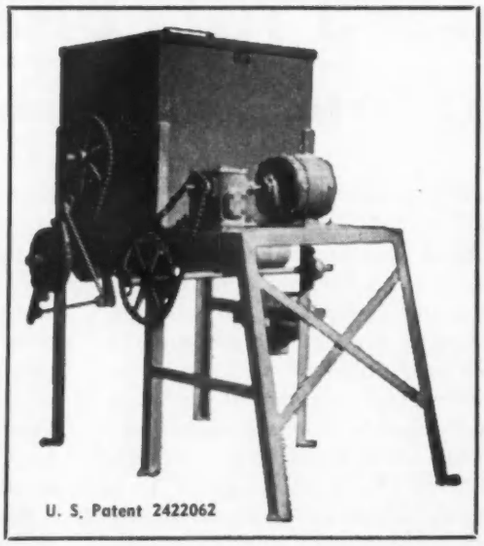
•

W. M. Osborn and **John T. Miller** have formed a partnership, **Osborn & Miller**, opening offices in Midland. The company will engage in geological consulting and general oil operations.

THE WESTERN CHEMICAL FEEDER
the dependable, economical water treater

CHECK THESE FEATURES:

- **Used in Oil Well Water Flooding, Municipal Water Treating Plants, Canneries, etc.**
- **Can be driven by water entering plant for treatment.**
- **Maintains pre-set water-chemical ratio through a wide rate-of-flow range.**
- **Adjustable two ways, to feed from a few pounds to several hundred pounds of chemicals per day.**
- **Also can be equipped with electric motor, or gas engine drive.**
- **Made to your specifications in various sizes.**
- **In use the world over.**



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Whatever your water treating problems may be, investigate the Western Feeder. Write for literature and prices.

For complete description see Page 2630 of the Composite Catalog.

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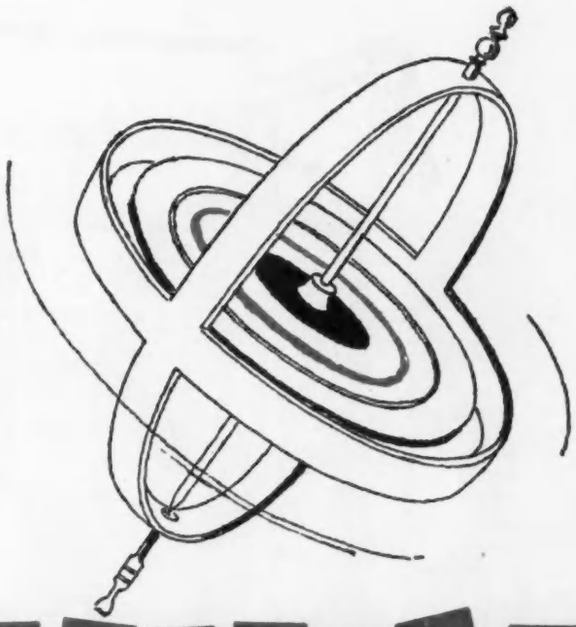
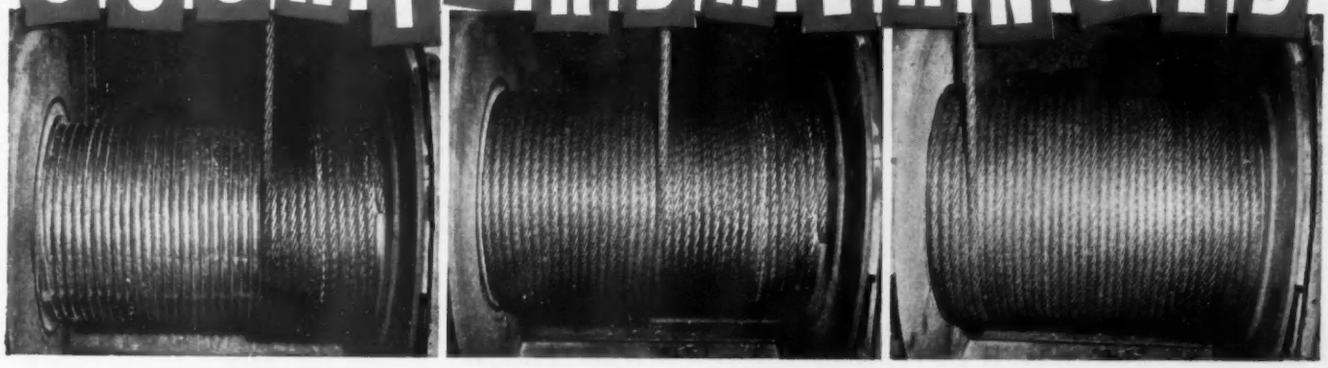
BALANCED



COUNTERBALANCED



Note that less line is needed at pick-up position on LeBus Grooved Drum. Plain drums usually require a layer and a half of line up to the pick-up point.

The line is crossing over in this photo as the line reaches the middle of the second layer. Notice even spooling.

The line has reached the fourth layer and is still spooling smoothly and evenly onto the LeBus Grooved drum.

LEBUS GROOVING & COUNTERBALANCE CONTROL PYRAMID SPOOLING SYSTEM

Consult a LeBus Engineer for details or write

Just as Scientists have attained "perfect balance" and "smooth running" of a gyroscope so has LeBus Engineered their Grooving and Spooling System for "perfect balance" and "smoother operation." With the LeBus GROOVING AND COUNTERBALANCE CONTROL PYRAMID SPOOLING SYSTEM, the wire-line crosses over at two points on directly opposite sides of the drum and causes the line to become "Counterbalanced." Previously there was only one cross-over point on the drum at which the line would build up diameter, causing the drum to have a slightly "Out of Balance" condition which could set up "Vibration" at high speeds or when going into the hole. LeBus has practically eliminated all vibration with their new system and through this system they still control and hold the pyramid action of the line as it builds up on the drum. Evidence of "Perfect SPOOLING" is pictured (above).

*PATENTED and OTHER PATENTS PENDING

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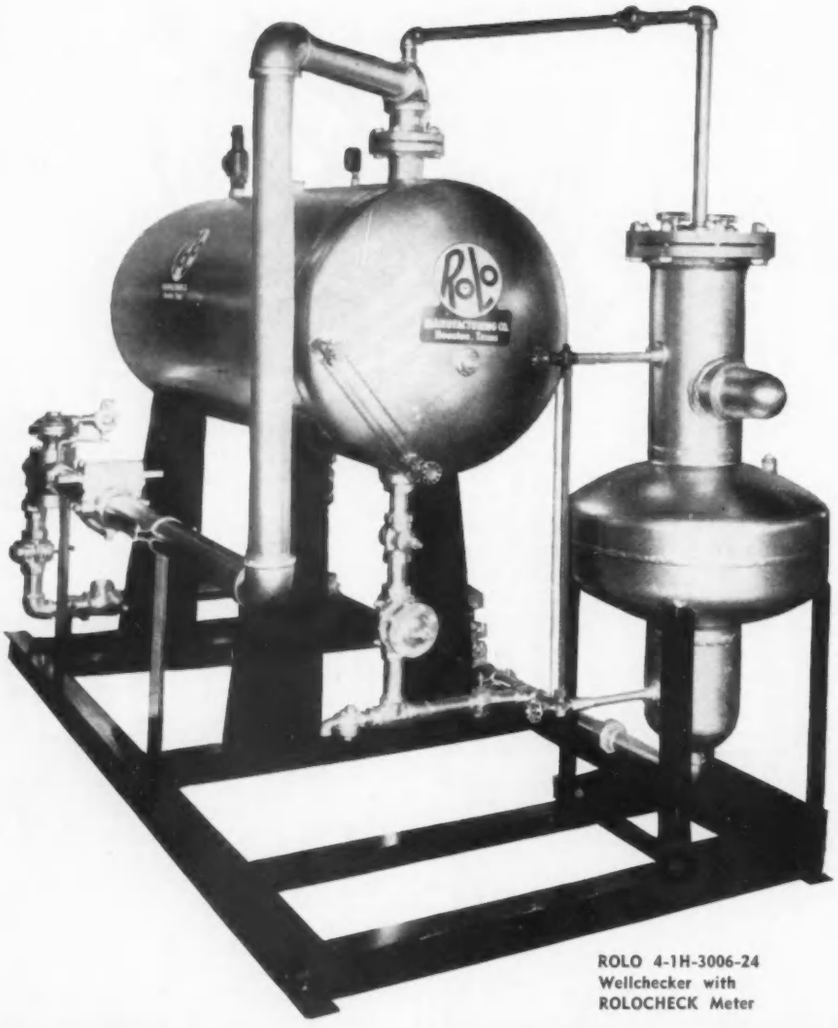
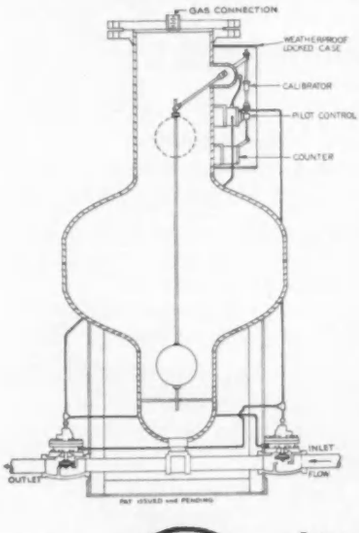


ROLO 4-1H-3006-24
Wellchecker with
ROLOCHECK Meter

ARE YOU GETTING YOUR MONEY'S WORTH FROM OIL WELL SEPARATING AND METERING EQUIPMENT?



You can buy a *complete* skid-mounted oil and gas separating and oil metering unit from ROLO, completely piped and ready to operate, for a price comparable to what most operators expect to pay for only the separator, component parts and field labor required to pipe and install . . . without an oil meter.

The ROLO 4-1H-3006-24 Wellchecker, one of a complete line of ROLO units, with ROLOCHECK Oil Meter, provides a high-efficiency, low-cost, low-maintenance separating and metering unit . . . the ROLOCHECK meter measuring crude at the separator and automatically dumping a positive calibrated dump each time with a high degree of accuracy. Unaffected by gas, the ROLOCHECK functions equally well with high amounts of foreign matter present.

An optional Free Water Knockout, employing the ROLOCHECK Water Meter, is available in every unit.

Write for complete details on how you can get the most for your money in individual well separating and metering units, from the leaders in crude oil metering equipment.

Cutaway of simple yet positive ROLOCHECK Meter.

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Joseph Townsend Wilson, Jr., has been elected assistant secretary and assistant treasurer of **Sun Oil Company.** He joined Sun as an auditor in 1941 after being employed by Price, Waterhouse & Company. In 1947 he was appointed manager of the General Accounting division of Sun's Accounting department.

•

Miller Quarles, Jr., has joined **Ralph E. Fair, Inc.** in San Antonio as geologist and geophysicist. He was formerly division geophysicist for Union Oil Company of California and assistant chief geophysicist for United Geophysical Company.

•

Ada Oil Company has announced the recent promotion of **S. L. (Steve) Kennedy** from local division manager to regional coordinating manager for operations handled by the Land, Geological and Production departments. He will work through the Texas district offices at Abilene, Borger, Midland and Wichita Falls.

•

Melville W. Sherwin has been made Gulf Coast division geologist, **Sohio Petroleum Company,** reporting to Division Manager **H. D. Henderson.** He formerly was staff geologist in New Orleans.

•

R. J. Dobson, chief exploitation engineer for **Shell Oil Company's** Houston area, has been promoted to area production superintendent. He replaces **W. S. Crake,** who has received an overseas assignment at The Hague. Taking over the duties of chief exploitation engineer is **H. J. ten Broeke,** who is being transferred to Houston from the company's Calgary, Canada, area.

Isaacs Is Gulf Publishing Ad Representative in Tulsa

James Isaacks, a member of the Gulf Publishing Company advertising staff for more than two years, has been named advertising representative in charge of a new territory with headquarters in Tulsa. The territory will include Oklahoma, Kansas and Arkansas. Issacks will handle accounts for WORLD OIL, PIPE LINE INDUSTRY and the COMPOSITE CATALOG, all Gulf Publishing Company publications.

James Isaacks

Isaacks is the son of a veteran Gulf Publishing Company employe, Eb Isaacks. He is a graduate in business administration from Baylor University and studied on his M.S. degree at the University of Denver. He held a commission in the U.S. Air Force and was a bomber pilot in the European Theater of operations during World War II.

He succeeds the late **William H. (Bill) Atcheson,** who was killed August 14 in an airplane accident in Kansas City.

WHEREVER YOU'RE LOCATED

there's a Bucyrus-Erie spudder distributor nearby

Here's an up-to-date list of Bucyrus-Erie spudder distributors, located throughout the United States and Canada, who are ready to fill your equipment needs. Check for the name of the distributor nearest you. Then see him soon for details on how Bucyrus-Erie spudders can save you money on your drilling and well servicing jobs.

SALES Your Bucyrus-Erie distributor carries the world's most modern and complete spudder line. Four models: 60-L, 28-L, 36-L, 48-L; maximum drilling depth, 6000 ft.; servicing, 7000 ft.

SERVICE Chances are your Bucyrus-Erie distributor began years ago in the drilling business himself. He knows drilling procedures inside and out. Extensive personal experience qualifies him to recommend tools and equipment to you.

PARTS Whenever and wherever you need tools or parts service, you needn't look far for help. There are 38 distributor outlets for Bucyrus-Erie spudders located in all principal oil fields of America. Each distributor has the facilities and parts inventories to keep your rig in top running condition.

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BECKWITH MACHINERY CO.	Pittsburgh (East Liberty), Erie, Bradford and Clearfield, Pa.
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BUCKEYE SUPPLY CO.	Zanesville and Wooster, Ohio; Wichita, Chase, Arkansas City and El Dorado, Kan.
DRILLERS SUPPLY CO.	Joplin, Mo.
DRILLING AND MINING EQUIPMENT CO.	Los Angeles, Calif.
GREAT NORTHERN TOOL & SUPPLY CO.	Billings, Cut Bank and Kevin, Mont.; Casper, Wyo.
IVERSON SUPPLY CO.	Tulsa, Oklahoma City and Okmulgee, Okla.; Ft. Worth., Midland, Odessa and Snyder, Tex.; Artesia and Farmington, N.M.
McJUNKIN CORPORATION	Charleston and Hamlin, W. Va.; Allen and Pikeville, Ky.
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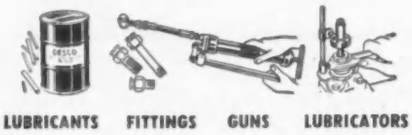

LUBRICANTS FITTINGS GUNS LUBRICATORS

DEATHS

Carl A. Young, 67, retired director of the Division of Production, American Petroleum Institute, died in Dallas August 30. Joining API as director of the Division of Standardization in 1924, he became director of the Division of Production when it was organized in 1930. He retired several years ago. Young was with J. F. Lucey Supply Company many years prior to joining the API, serving for a time in Roumania and Russia. He resigned as vice president in charge of manufacturing for the company to join the Institute where his major activities were standardization of oil field equipment, promotion of engineering studies on drilling and production practice, development of recommended practices on measuring, sampling and testing crude oil, natural gas and natural gasoline, vocational training of oil field workers and supervisory development.

Barton A. Myers, 70, died August 28. He had spent 45 years in the service of Standard Oil Company of New Jersey and its affiliates, 22 of which were in foreign fields including Mexico, South America, the East Indies and Canada. When he retired in 1949 he was vice president in charge of production for International Petroleum Company, Ltd., Toronto. Since retirement he had been an independent producer and consultant.

Francis S. King, 66, died August 27 in Tulsa. An assistant to the manager of manufacturing of Tide Water Associated Oil Company, he had been with the company 29 years.

John Van Wagner, 59, independent operator in Houston 20 years, died July 29. At the time of his death he was president of Oceanic Petroleum Company, operating in Texas and Oklahoma.

Joseph R. Pearson, 75, independent oil operator and philanthropist of Los Angeles, died August 15. Before going to California, he had been actively engaged in oil operations in North Texas.

Hugh S. Chancey, 52, president of the Portable Drilling Corporation and vice president of the Gackle Drilling Company, died August 21. A pioneer in the development of unitized rotary drilling rigs, he was widely known in oil circles. In 1935 he organized the Unit Rig and Reel Company and was a co-owner until 1947. He organized Portable in 1936, and the Gackle firm in 1951.

Carl J. Taylor, 60, assistant to the president of Cities Service Gas Company, died August 6. He joined the company in 1946

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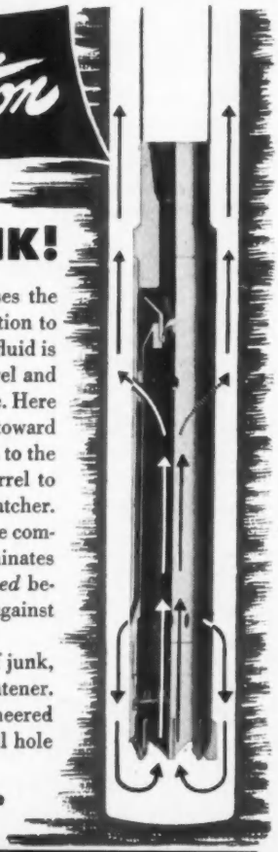
BRINGS IN JUNK!

THE BOWEN JUNK BASKET uses the unique principal of reverse circulation to PULL objects into the basket. Circulating fluid is diverted through side passages in the barrel and against the full circumference of the hole. Here the fluid is deflected, moving all objects toward center. Fluid flows in a continuous stream to the center of the tool and up through the barrel to return ports pulling all objects into the catcher. This reverse circulation action assures more complete recovery of junk in the hole and eliminates misruns. *Full pump pressure can be utilized* because there's no danger of pressure bearing against and causing loss of the fish.

An ideal tool for recovering all types of junk, for coring purposes, and as a hole straightener. Comes in sizes from 4⅝" to 17½" and is engineered to recover all types of bit cones used to drill hole sizes within its range.

For details – call the Bowen Service Store in your territory or write direct.



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EXPORT OFFICE:
30 ROCKEFELLER PLAZA
NEW YORK CITY, NEW YORK
EXPORT REPRESENTATIVE: VAL R. WITTICK, JR.

and was made assistant to the president in 1953.

•

P. A. Percy, 50, district sales manager of Hughes Tool Company, died recently in Oklahoma City. He had been with the firm more than 20 years.

•

Ernest Fosshage, operator of a well-logging service at Amarillo, Texas, covering the Texas and Oklahoma Panhandle areas, died August 20.

•

Carl E. Duffield, 73, pioneer Tulsan and independent oil operator, died August 20. He went to Tulsa in 1904 from Venango County, Pennsylvania, and was a partner in the pioneer oil firm of Howard, Duffield and Berlin.

•

Sam Schusterman, 62, owner of the S & S Pipe and Supply Company, died July 27. He had operated the oil field supply firm 20 years.

•

Ofa I. Peugh, 60, formerly superintendent for Williams Brothers Construction Company, died July 27. He was with Southwestern Bell Telephone Company before joining Williams Brothers 20 years ago.

•

Tom C. Craig, 52, Phillips Petroleum Company, died July 26 in Amarillo, Texas. He was head of the company's Natural Gas division in the Panhandle.

•

John H. Collier, 70, former president and chairman of the board of Crane Co., died July 27 in Fairfield, Conn. He was president of the company from 1941 to 1946 and served as chairman of the board from 1946 to 1951.

•

Edgar M. Clark, former vice president and director of Standard Oil Company of New Jersey and co-inventor of the first successful cracking process in the petroleum industry, died August 1 at Phoenix, Ariz. He joined Standard Oil of Indiana in 1890 and moved to Standard of New Jersey in 1916. He was elected vice president in 1930 and retired in 1933.

•

Joseph N. Dwight, in charge of the Production Equipment department for Lucey Products Corporation, until his retirement in 1952, died August 1 at Guthrie, Okla. He long was associated with the oil field equipment business and at one time worked for International Supply Company and also formed his own company, Moran and Dwight.

•

Thomas A. McElheny, 47, a member of BJ Service, Inc., since 1941, died June 15. He recently had been promoted to the position of Pacific Coast division sales supervisor.

•

E. C. (Bud) Carter, 54, Houston drilling inventory and appraisal expert, died August 31 in New Orleans. Prior to launching his own business, Carter was affiliated with The National Supply Company as a rotary equipment specialist for over 20 years.

IVERSON
SUPPLY COMPANY

FASTEST
SUPPLY STORE SERVICE
IN THE SOUTHWEST. . .

FIRST
IN THE
OKLAHOMA CITY
AREA

CHECK WITH IVERSON
whatever your requirements

The IVERSON SUPPLY STORE in Oklahoma City is just one of the many IVERSON SUPPLY STORES serving the oil industry in the Great Southwest.

IVERSON SUPPLY STORES are known in this territory for the speed and efficiency with which customers orders are filled. All of our supplies are backed by the manufacturers integrity, and the IVERSON guarantee of satisfaction.

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● ***HERMETICALLY SEALED CONTACT***

Always dependable—whether it operates once per year or several times per minute. It remains operative at all times because dust, dirt, grease or moisture cannot contaminate the contacting elements. There can be no sticking or welding of the contact points.

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Independent outside adjustments are provided for setting both the cut-in and cut-out points. Differential may be widened as desired. No tools are required.

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No guesswork or calculations are required—the pointers indicate on an accurately calibrated dial, the exact operating pressures or temperature.

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You can tell at a glance whether switch circuit is on or off.

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All operating ranges for Series DA-21, DA-35 and DA-55.

Available for general use, outdoor use or hazardous locations.

WRITE FOR BULLETIN 4B

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

What's Happening

AMONG INDUSTRY ASSOCIATIONS

R. C. Dunlap

Dave P. Carlton

George A. Grimm

Norman Ricker

Exploration Geophysicists Announce 1955-56 Officers

In a mail ballot election, R. C. Dunlap, Jr., vice president of Geophysical Service, Inc., was elected president of the Society of Exploration Geophysicists for 1955-56. Dave P. Carlton, chief geophysicist of Humble Oil & Refining Company, will be vice president; George A. Grimm, district geophysicist for Tide Water Associated Oil Company, is new secretary-treasurer.

Dr. Norman Ricker, senior research physicist for The Carter Oil Company, was elected editor of the society for a two-year term.

The new members of the SEG executive committee will take office at the close of the society's 25th annual meeting October 6 in Denver.

Dunlap formerly was secretary-treasurer and president of the Pacific Coast section of SEG; secretary-treasurer of the national association in 1951-52 and general chairman of the Midwestern regional meeting in Dallas in 1954.

Oklahoma City to Be Site Of Regional AAPG Meeting

Technical papers following the theme "The Permian and Pennsylvanian of the Mid-Continent and Panhandle Areas" will highlight the Mid-Continent regional meeting, American Association of Petroleum Geologists, to be held in Oklahoma City November 2-4.

With the Ardmore, Panhandle and Shawnee Geological Societies as hosts, the meeting will be sponsored by the Oklahoma City Geological Society in cooperation with the Mid-Continent Council of Geological Societies.

Eighteen papers are to be presented during the technical sessions, with a one-day field trip through the Arbuckle Mountains scheduled for November 5, the day after the convention. Dr. W. E. Helm of the Oklahoma Geological Survey, will lead the trip.

Ellison Re-Elected Head Of Kentucky Oil, Gas Group

George Ellison has been re-elected president of the Kentucky Oil & Gas Association for 1955-56. Other officers include J. C. Preston, secretary-treasurer; Angus W. McDonald, secretary-manager; and M. G. Powers, K. Z. Wilking, Frank J. Zogg and O. H. Horner, vice presidents.

Houston University, AIME To Sponsor Symposium

A total of 14 papers will be presented during the two-day symposium on formation evaluation to be held in Houston October 27-28. Sponsors of the event are the Gulf Coast Section AIME, University of Houston student chapter, and the Department of Petroleum Engineering of the University. While covering all varied phases of the topic, all papers will contain some treatment of possible future development and application. An equipment display also will be on view during the two-day session.

Illinois Geological Survey To Observe Anniversary

The Illinois State Geological Survey will observe its fiftieth anniversary at a special two-day meeting October 11-12 to be held at the Natural Resources building on the University of Illinois campus in Urbana. Thurlow G. Essington, chief counsel, Illinois Coal Operators' Association, will preside at the opening session at which Dr. Morris M. Leighton, chief, emeritus, Illinois State Geological Survey, will talk on the Survey's response to the economic pattern of the past 50 years.

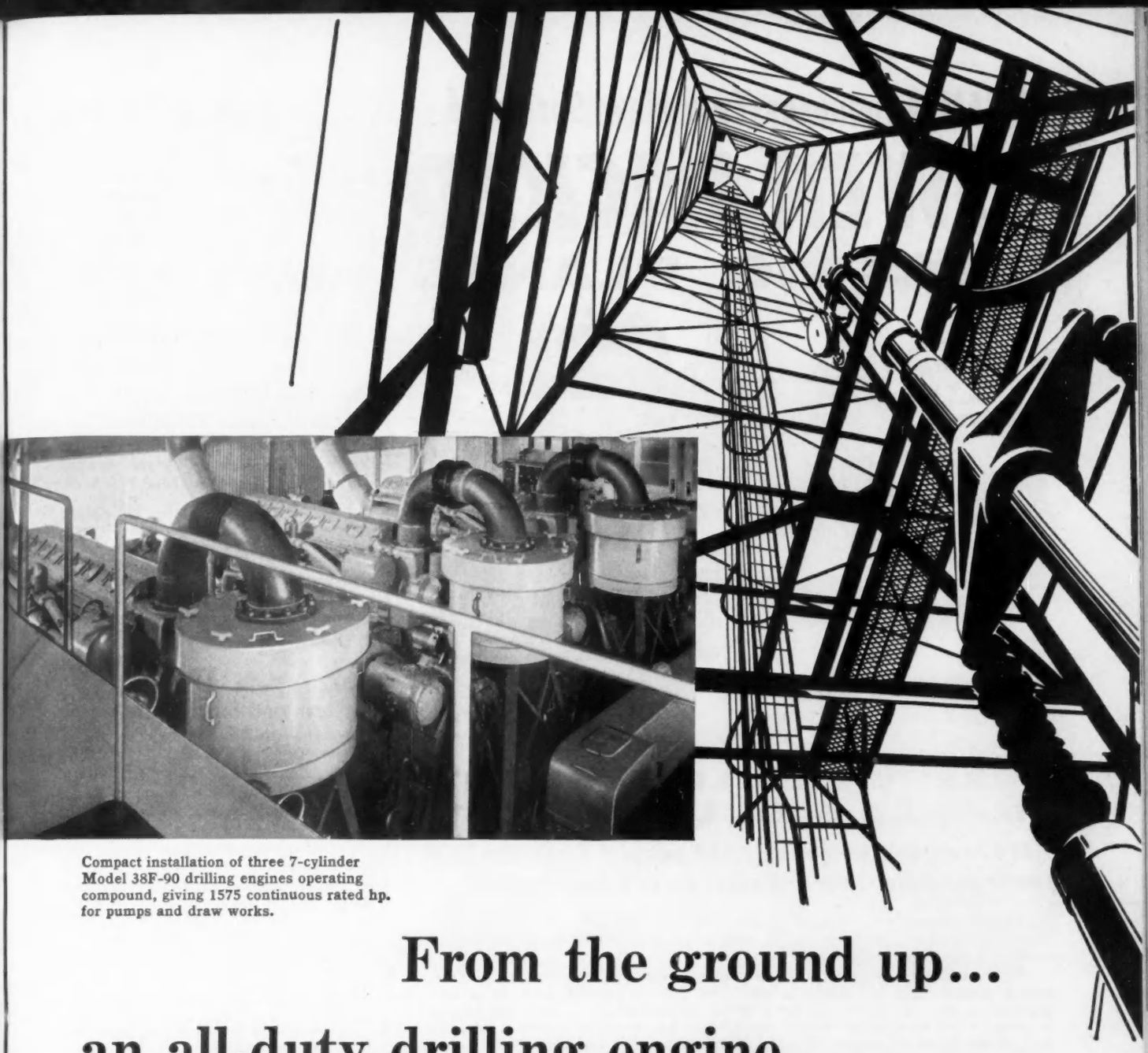
Other speakers include J. R. Van Pelt, president, Montana School of Mines and director Montana Bureau of Mines and Geology; B. R. Gebhart, vice president, Freeman Coal Mining Corporation; Vincent J. Nolan, independent oil producer; and Norman J. Dunbeck, vice president, International Minerals and Chemical Corporation.

Martin to Head Division Of Rocky Mountain Group

As new central division manager for the Rocky Mountain Oil and Gas Association, Robert H. Martin will be in charge of RMOGA activities in Wyoming. He has been with the James E. Emrock Company in Casper for over four years, after serving with the Casper Morning Star and the Torrington Telegram.

Chipman Reelected Head Of Pennsylvania Oil Group

Charles A. Chipman was reelected to his third one-year term as president of the Pennsylvania Grade Crude Oil Association at a recent meeting of the directors of the association in Pittsburgh. George J. Hanks,



Compact installation of three 7-cylinder Model 38F-90 drilling engines operating compound, giving 1575 continuous rated hp. for pumps and draw works.

From the ground up... an all-duty drilling engine

From block to flywheel the Fairbanks-Morse Model 38F has all the features you expect to find in a rugged, responsive engine for continuous service under the shock and strain of field service. Such as . . .

High Power . . . output for continuous service—at low b.m.e.p. and low piston speed—makes the Model 38F a dependable, low-maintenance power package. Rated speed extends to 1200 rpm. for continuous service, making it ideal for economical application to mechanical compounds, hydraulic couplings, torque converters, electric couplings or full electric drives.

Fast Response . . . is a plus feature of two-cycle design that gives extremely rapid speed acceleration for faster pipe handling and yet is practically vibration free at all operating speeds. And there's instant reserve power in the 38F to handle overloads and emergencies.

Low Maintenance . . . easier inspection and operation are inherent advantages of the Opposed Piston design that eliminates 40% of the moving (wearing) parts found in engines of comparable rating. Liners, pistons and rings are far easier to get at than in an engine where a head—its connections and gasket—has to be removed.

All Fuel . . . natural gas, propane or diesel oil. On each fuel the Model 38F operates at high (diesel) compression, insuring highest fuel economy and cleanest operation. Ask your nearby Fairbanks-Morse Oil Field Engineer for complete data on the line of Model 38F engines available in six power sizes of 4, 5, 6, 7, 8 or 10 cylinders —continuous slush pump rating of 75 hp. per cylinder. Fairbanks, Morse & Co., Chicago 5, Illinois.

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ONAN Announces Two New Series of

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MORE POWER, LESS WEIGHT, SMALLER SIZE, LOWER COST!

2,500-watt unit weighs only 154 pounds! Gives you more power per dollar than any other 4-cycle electric plant.

Higher output in a smaller, lighter package give these new Onan units marked advantages for every type of service . . . portable, mobile, primary, or emergency standby.

Wherever you use *portable* electric plants, you can now put more cost-cutting electric light and power to work for you . . . at less cost. In *mobile* applications you can take along more power in less space . . . with less weight. In *primary* and *emergency* standby applications you get more power at less cost with all the Onan advantages of quick starting, long life and easy maintenance.

These new units are *completely Onan-built,* with Onan engines direct-connected to Onan generators in a single compact unit. The new, modern, *short-stroke,* single-cylinder, 4-cycle engines feature extra-large bearings and free-breathing intake and exhaust systems to give you thousands of hours of operation without major servicing. Generators are drip-proof and specially insulated for all-climate, all-season use.

Equipped with carrying frames or two-wheel rubber-tired dollies, Onan AJ and AK series electric plants can be taken anywhere . . . moved around easily on the job.

See your Onan distributor or write for new folder describing all 18 new models

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AK A.C. MODELS 500 and 750 watts, 115 or 230 volts.

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chairman of the board of South Penn Oil Company, was reelected first vice president; A. C. Simmons, Simmons Oil Company, second vice president; and Fayette B. Dow, vice president and general counsel.

Other officers reelected include Samuel Messer, Quaker State Oil Refining Corporation, treasurer; F. W. Alcorn and C. L. Suhr, The Pennzoil Company, and C. G. Johnson, Quaker State, assistant treasurers; and W. C. Wenzel, executive manager.

C. E. Swain, Hancock Oil Company of California, has been elected a new member of the board of directors.

Canadian Oil Tax Society Elects McGreer President

D. M. McGreer, Sun Oil Company, has been elected president of the newly-organized Canadian Petroleum Tax Society in Calgary, Alberta.

J. B. Fraser, Canadian Gulf Oil Company, is first vice president; J. R. McCormick, Shell Oil Company, second vice president; O. C. Windrem, Texaco Exploration Company, secretary; and W. H. Atkinson, Oilwell Operators, Ltd., treasurer.

Blanche Kelley Honored By Desk and Derrick Club

On the fifth anniversary of the Los Angeles Desk and Derrick Club, Blanche Kelley, Union Oil Company of California, was named honorary president in recognition of outstanding performance and leadership. She served as charter president after instigating formation of the group in 1950, and was also one of the organizers of the Association of Desk and Derrick Clubs of North America in 1952. She served as first vice president of the national association that first year.

The Los Angeles club, second of its kind organized in North America, is now one of 100 Desk and Derrick Clubs in the United States and Canada.

Andrews to Head California Conservation Committee

The Conservation Committee of California Oil Producers has elected Paul Andrews, of Signal Oil and Gas Company, chairman for the coming year. He has served on the committee nine years, and at present is chairman of District 26, representing operators of the Wilmington field-Harbor area.

The committee conducts a program for oil conservation in California oil fields to increase underground recovery on a voluntary basis. The program is supported by a majority of oil operators.

Other officers elected were R. C. Gentry, Standard Oil Company of California, first vice chairman; E. Robert Burns, MacDonald and Burns, second vice chairman; and C. W. Stephens, The Ohio Oil Company, secretary.

The committee is made up of the chairmen and vice chairmen of the 30 oil producing districts into which the state is divided and two representatives-at-large, all elected by oil producers in the state.

Geophysics Society Plans Silver Anniversary Meeting

The twenty-fifth annual meeting of the Society of Exploration Geophysicists, to be held at the Shirley Savoy Hotel in Denver October 3-6, will feature a silver anniversary celebration to honor charter members. The technical program will include papers on petroleum and mining geophysics of interest to those engaged in all phases of mineral exploration.

NACE Permian Basin Tour To Be Held October 12-14

The sixth annual Permian Basin Corrosion tour, sponsored by Permian Basin Section, National Association of Corrosion Engineers, will cover an estimated 3000 square miles in the vicinity of Odessa. About 300 pieces of equipment will be available for inspection in 60 exhibits during the three-day session. Headquarters will be the Lincoln Hotel, Odessa.

NACE South Central Group Sets Meeting Acitvities

Ten symposia and at least 19 meetings of technical committees are on schedule for the 1955 South Central Region meeting of the National Association of Corrosion Engineers. Sessions will be held at the Houston Hilton-Shamrock Hotel October 18-21.

Symposia will cover utilities, chemical industries, pipe line corrosion, recirculated cooling water corrosion, high temperature corrosion, cathodic protection, inhibitors, oil and gas well corrosion, protective coatings and marine corrosion.

New Mexico to Be Site Of Geological Field Trip

Truth or Consequences, N. M., will be headquarters for the three-day field conference scheduled November 11-13 by the New Mexico and Roswell Geological Societies.

The first day of this sixth annual conference, Paleozoic section of the San Andres Mountains, which lie within the restricted area of the White Sands Rocket Project, will be examined under leadership of Dr. Frank Kottlowski. Dr. Richard A. Jahns and Dr. Clay T. Smith will lead a trip to the Cuchillo Mountains November 12, and the final day will be spent in the Caballo Mountains where the complete section from pre-Cambrian to Tertiary is exposed. Dr. Vincent Kelley, Caswell Silver and High Bushnell will supervise the third trip.

Winnipeg Desk and Derrick Names McCombe President

Lorraine McCombe, Imperial Oil Limited, has been named first president of the newly-organized Winnipeg, Canada, chapter of the Desk and Derrick Clubs of North America. Jacqueline Fleming, Manitoba Department of Natural Resources, was elected vice president; Ann Bit, Manitoba Bridge and Engineering Works Ltd., recording secretary; and Mrs. Albert Wilson, Oil In Canada, Winnipeg, corresponding secretary and treasurer.

• It's wise to standardize with these WECO Compounds for tool joints and drill collars. Every gallon of these WECO Compounds has the same unvarying high quality—the same dependable assurance of proper thread lubrication and protection for string after string of drill pipe and drill collars.

Immediate availability, today and tomorrow, is another important reason why it's wise to standardize with WECO Compounds. Wherever you are—whenever you need them, you can always count on getting WECO NO-GALL and LO-TORK to protect tool joint and drill collar threads.

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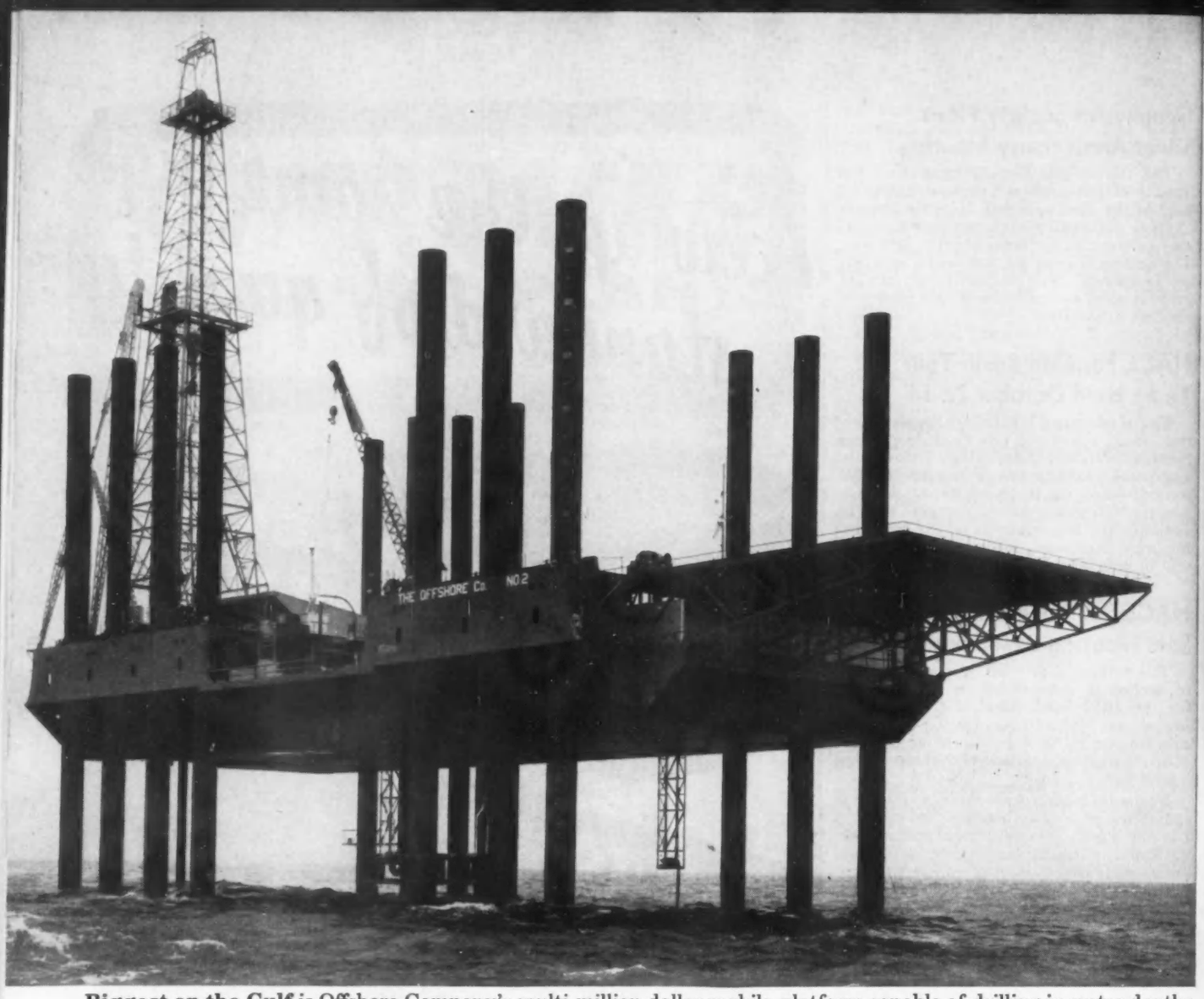


Biggest on the Gulf is Offshore Company's multi-million dollar mobile platform capable of drilling in water depths of 100 feet to explore for the rich oil and gas reserves of the Miocene Trend miles below the ocean floor.

The Big Wildcatters Are Choosy

Where they're playing for million-dollar stakes, oilmen count on Pittsburgh Steel Company's seamless oil country goods to help lower the odds.

Offshore Company's $3.8 million mobile platform No. 2 is the largest entry in the sweepstakes for the rich oil and gas reserves below the ocean floor in the Gulf.

This ocean-going monster weighs as much as a tanker and has deck dimensions slightly smaller than a football field. It carries a 146-foot high drilling rig on its back, is generously equipped for fast drilling, and has first-class crew quarters.

When it moves into position, its fourteen sea legs are lowered and air-jack driven into the ocean floor. Each is a 6-foot diameter steel caisson, 200 feet long and weighing 100 tons. Then the barge climbs up the caissons until it is at a safe operating level above water, and begins drilling.

Once on location its towering framework can be battered by hurricane winds and lashed by waves. Yet it won't budge. Its powerful drilling equipment is built to stab through miles of earth beneath the ocean to reach pay quickly.

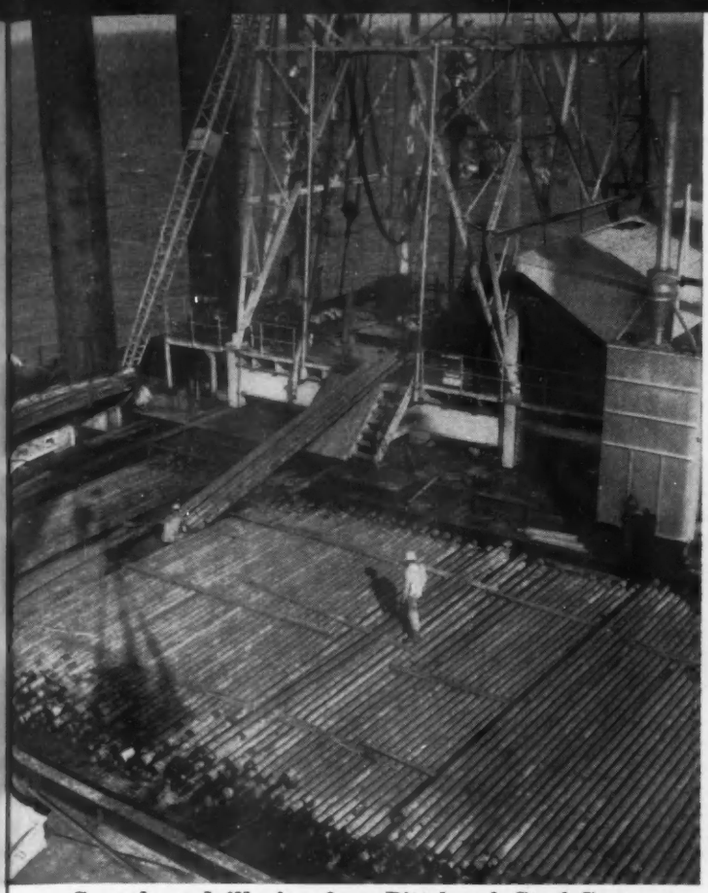
When you consider the large investment and heavy costs involved, you can understand why oilmen who operate equipment such as this can't afford to take chances on equipment or service.

The pay-off comes on the footage of hole drilled. All time and expense that does not deepen the hole, lowers profits. Equipment failures or service delays pile up losses rapidly.

The fact that this rig is equipped with Pittsburgh Steel Company's seamless drill pipe is a credit to the quality of the product. To oilmen who have relied on Pittsburgh seamless for more than a half-century, its selection is not surprising.

Offshore No. 2 is using 5-inch OD Grade E Range 2 drill pipe. It has a minimum yield strength of 75,000 psi, and needs every pound of it.

Rotating at 120 rpm and drilling an average of 500 feet of hole a day, as it was on the operation shown



Seamless drill pipe from Pittsburgh Steel Company, racked on the barge deck, is fed length by length into the hole as it deepens in the race to reach pay.

High above the ocean a derrick man stabs a stand (three 30-foot lengths) of drill pipe into the hole. This pipe goes in at better than a stand a minute.

here, the drill pipe at the top of the hole may be under a tension of well over 100 tons. It is subject to continuous fatigue and torsion. Abrasive and corrosive wear also are always present.

Pittsburgh seamless, along with other equipment for Offshore No. 2 was supplied through one of the independent distributors listed at right. The selection of an independent to provide the fast and flexible service needed for a rig such as this was natural.

As the barge reached its finishing stages prior to launching, the independent's field representative stood by on 24-hour alert. The mobile telephone in his car was busy with calls to his warehouse for instant delivery of required parts.

Now he calls regularly at the dock from which the rig is serviced, continuing his 24-hour, 7-day a week vigil to cut any costly delay that might occur. He provides the same experienced, personal service—free from red tape, cluttering paperwork, and remote control—that is the specialty of all independents on the list.

The next time you need a string of drill pipe, casing, or tubing, why not get the pipe of your choice through the supplier of your choice? Specify Pittsburgh seamless!

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Franklin Supply Company
624 South Michigan Avenue
Chicago 5, Illinois

Houston Oil Field Material Co.
1524 Maury Street
Houston, Texas

Industrial Supply Company
500 Eighth Street
Wichita Falls, Texas

Iverson Supply Company
400 West Fifth Street
Tulsa, Oklahoma

Lucey Export Corporation
233 Broadway
New York 7, New York

Lucey Products Corporation
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Tulsa 19, Oklahoma

McJunkin Corporation
P. O. Box 513
Charleston 22, West Virginia

Midland Supply Company
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Washington St. Station
Wichita 7, Kansas

Mountain Iron & Supply Co.
100 Rule Building
Wichita 2, Kansas

Murray Brooks, Incorporated
P. O. Box 855
Lake Charles, Louisiana

Norvell Wilder Supply Company
P. O. Box 4145
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Producers Supply & Tool Co.
706 Commercial Standard Bldg.
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Rodman Supply Company
P. O. Box 2752
Odessa, Texas

Southwest Supply Company
1720 Oliver Building
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Superior Iron Works & Supply Co.
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Western Supply Company
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SUN DUAL - FLOW OIL FILTERS REFINE AS THEY FILTER

Patented double - jacket design preheats lubricant and maintains constant temperature while oil is filtered. A ¼" space between outer wall and inner jacket permits preheating of lubricant . . . without use of an auxiliary heater.

All SUN filter elements fasten to the under side of the filter lid and give the operator full opportunity to check the seal of the element to the discharge connection. This feature eliminates any channeling of unfiltered oil.

The SUN filter embodies every feature engineeringly possible to assure positive filteration and maximum efficiency.

Available at supply stores everywhere.

The SUN Earth filter elements are constructed in cartridge form — eliminating the need to fill elements and bypassing the danger of getting the earth filler scattered inside the filter case. The element bag is made of 8 - oz. white cotton duck. Gives long service in spite of acids, dirty lube and fuel oils.

Other Sun Filters

- SUN Regular Flow Oil Filter
- SUN Diesel Fuel Filters
- SUN Earth Filter Element
- SUN Fibre Filter Element

SUN ENGINEERING CO.

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GOING FISHING? ACME CALL YOUR FRIEND!

Companies in the News

Union Oil Builds in Los Angeles

Union Oil Company of California's new $20 million headquarters is scheduled for completion early in 1957 at Union Oil Center west of Harbor Freeway overlooking downtown Los Angeles. To be located on a hill, the diamond-shaped 13-story building will be the highest structure in the city. Three harmonizing office and service structures are to be built at the Center, providing one million square feet of floor area, including a three-level underground garage for 1500 cars. This view shows the building as it will appear from downtown Los Angeles. Smaller structure in foreground will house auditorium and employes' lounge. Not shown are two wing buildings to the back of the main structure.

O. F. WARREN EXPLORATION COMPANY has been formed under the laws of Oklahoma by **O. F. Warren**, president and owner of O. F. Warren Corporation of Tulsa. The exploration company, formed to discover and produce oil, has holdings in the Williston Basin of North and South Dakota and in Oklahoma. Activities, at present, will be centered in the Mid-Continent area.

•

CORAL DRILLING COMPANY has been formed in Fort Worth as a contract drilling firm specializing in offshore operations in the Gulf of Mexico. The new company, which is operating from offices at 6100 Camp Bowie Boulevard, was incorporated June 17 as a Delaware Corporation. Officers include **Ted Weiner**, president; **Marvin M. Miller**, vice president; **T. R. Weymouth**, vice president; **Edward L. Hay**, secretary; and **Vernon Jones**, treasurer.

•

SHELL OIL COMPANY has announced that $350,000 will be provided in 1955 by the Shell Companies Foundation, Inc., as direct aid to U. S. higher education. The

made for rugged use...
in plant—office or field

Gotkool
water cans and coolers

"GOTKOOL" Water Cans are easily portable for field use . . . and **"GOTKOOL" Water Coolers** are especially designed for use in office, store, or plant. Both have extra large top openings. Snug-fitting, easily removable tops protect water from impurities. Heavy construction with heavy double-locked, sweat-soldered seams. *Buy* **"GOTKOOL"** *at your supply store today.*

GOTKOOL Water Cooler — made in 2, 3, 5, 8, 10, 15, and 20-gallon sizes with extended or recessed flush-mounted faucet optional. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

GOTKOOL Water Can — made in 1½, 2, 3, 5, 10, and 20-gallon sizes without faucets. Extended or recessed flush-mounted faucets available at slight additional cost. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

KEEP PURE DRINKING WATER ALWAYS HANDY

money will be used for education of scientists and development of research at 41 different colleges and universities through the 1955-56 academic year. The fund provides 49 fellowships and 20 research grants in fields of business administration, chemistry, chemical engineering, engineering mechanics, geology, geological and petroleum production engineering, geophysics, mathematics, mechanical engineering, metallurgy-corrosion, physics and plant science.

•

TRUE AND BROWN OIL PRODUCERS, INC., Wyoming independent oil company, has announced the change of company name to True Oil Company, following purchase of D. S. Brown's interest in the company. H. A. True and J. D. True are partners in the firm. Also, the name of True and Brown Drilling Contractors has been changed to True Drilling Company.

•

DEEP ROCK OIL CORPORATION'S board of directors has approved a change in the name of the corporation to Crescent Corporation. The present directors of Deep Rock will continue with the company. **W. H. Garbade** continues as president, with **W. F. Styler, Jr.,** as vice president and treasurer, and **C. A. Houy** as vice president in charge of exploration and production. Crescent will continue to head quarter in the Atlas Life, Building, Tulsa.

•

SINCLAIR OIL & GAS COMPANY has moved its Kansas Land and Geological department from the First National Bank building at Wichita, Kansas, to 101 Insurance building. Don W. Payne is district geologist. The production department office remains at Chase, Kansas, with William B. Rhees as production superintendent. Sinclair Crude Oil Company also moved its offices to the new building.

•

LYONS, McCORD and LOGAN, independent operators of Shreveport, have announced the opening of a district exploration office in the Heymann oil center in Lafayette, La. **Roger H. Ogden,** former chief geologist for Arkansas-Louisiana Gas Company, has been named manager of the office. The company has oil properties in Arkansas, Louisiana, Mississippi, New Mexico and Texas.

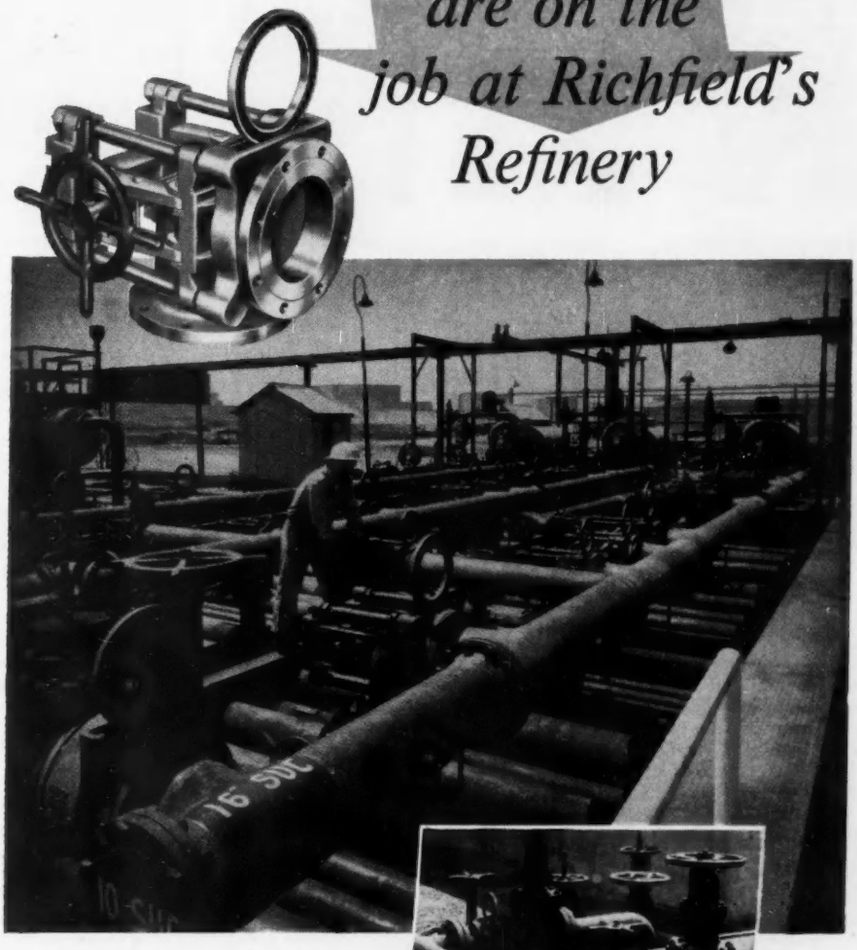
•

RICHFIELD OIL CORPORATION, as oil industry exhibitor in the new Disneyland playground in Anaheim, Calif., will have a three-part show featuring the basic facts about oil production. Titled "The World Beneath Us," the show will feature a cartoon film, a Diorama model of the Los Angeles basin and a working model of an underground oil reservoir complete with flowing wells and sub-surface storage facilities.

•

THE AMERICAN OIL COMPANY has set aside $35,000 for use during 1955 in aiding privately-financed, four-year liberal arts colleges in 15 eastern states. The company will distribute the unrestricted grants to various state and regional associations of private colleges which, in turn, will allocate the funds to 162 member colleges. States initially involved are Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Ohio, West Virginia, Virginia, Maryland, North Carolina and South Carolina.

Impenetrable Sealing
HAMER BLINDS
are on the job at Richfield's Refinery



After testing their action in a trial installation, Richfield now uses Hamer Line Blinds extensively at its refinery at Watson as illustrated above.

HAMER *Visible Shut-off* LINE BLIND VALVES

HAMER *Plug Valves*

Thousands of users have proven the easy and immediate operation of Hamer Plug Valves. Will not stick or freeze.

Refinery operations require a valve that will provide a continual leakproof line shutoff. Hamer Blinds with their foolproof sealing action are unsurpassed for providing an absolute line seal that's both positive and permanent. In addition, Hamer Blinds fast, one minute, one man operation literally pay for their cost in downtime saving.

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Representatives throughout the World

What's Happening

AMONG SERVICE AND SUPPLY MEN

Kenneth O. Hoevel

James S. Blair

Sam P. Stone

George A. Seaver

Ken S. Ramey

Abe Haglund

R. J. Granberry

R. C. Wilshusen

O. B. Avent

Jack E. Brown

Claude Alexander

Albert E. Stringer

Kenneth O. Hoevel has been appointed division manager of the Midwest division of **The National Supply Company** succeeding **Denzel G. Mann,** who has retired after 44 years with the company. Hoevel started with National Supply in 1935 as a store clerk. He served as division sales manager of the Midwest division from 1944 to 1953, when he was promoted to division manager of the Northwest division. **James S. Blair, Jr.,** Eastern district manager for National Supply in Venezuela, has been appointed manager there, with **Lynn L. Leigh** named to the newly-created position of assistant manager. Blair joined National Supply in 1941 as warehouseman and field salesman. He was transferred to the Export division in 1947, serving in Trinidad and Venezuela.

•

Avondale Marine Ways, Inc., recently announced the appointment of **Sam P. Stone** as vice president. Stone, who joined Avondale in 1945, will be in active charge of the Engineering department which just completed its new building housing all engineering and research activities of the company. An engineer and architect, he formerly was with Allen Boat Company, Inc. and Superior Barge and Shipbuilding Company.

•

Aeroquip Corporation recently announced the appointment of **George A. Seaver** as vice president and general manager of **Marman Products Company, Inc.,** of Los Angeles, subsidiary of Aeroquip. Seaver will be responsible for all sales and manufacturing functions of the firm, which manufactures clamps, couplings, straps and related items for aircraft and industrial applications. Seaver formerly was general manager of Norcor Manufacturing Company.

Axelson Manufacturing Company, Division of U. S. Industries, Inc., has announced the appointment of **Ken S. Ramey** as sales manager for the Petroleum Equipment division at Los Angeles. Ramey succeeds **J. R. Walker** who continues with Axelson as consultant on marketing and distribution problems. Ramey has been Mid-Continent manager in Tulsa since 1950. He joined the company in 1923. **Abe Haglund** has returned to Axelson as sales manager of the Milling Machine division. Starting with the company in 1911 as a machinist, he later became works manager and company delegate to Europe and South America. In 1944 Haglund joined Griffin Ross Machinery Company as distributor for Axelson lathes in southern California.

•

Core Laboratories, Inc., has announced the appointment of **R. J. Granberry** as district manager of the company's Upper Gulf Coast operations from offices in Houston. Granberry is a member of Core Lab's board of directors and has served as district manager in Corpus Christi eight years. He joined the firm in 1941. **R. C. Wilshusen** has been promoted to district manager and assigned to the Corpus Christi area. Employed by Core Lab in 1948, Wilshusen has served as assistant district engineer in the Oklahoma-Kansas area since 1951.

•

O. B. Avent, recently named vice president of **Welex Jet Services, Inc.,** will be in charge of all field operations. He had been operations manager since 1954, moving up from managerships of the Ardmore, Okla., and Wichita Falls, Texas, district offices. **Jack E. Brown,** with Welex over three years, has been named assistant manager of the new district office at Farmington, N. M. At Winfield, Kansas, **Claude Alexander** has been appointed sales engineer, and at Ardmore, **Albert E. Stringer** has been appointed sales engineer. Alexander, a veteran of ten years of oil field work, has been with Welex two years as rigger and shooter. Stringer has been with Welex in various positions seven years.

•

E. S. Russey and **A. W. Rose** have been elected vice presidents of **Borg-Warner Corporation.** Russey is president and general manager of the Warner Gear division in Muncie, Ind.; Rose is Pacific Coast representative of the corporation, with headquarters in Los Angeles. Russey first joined Warner Gear in 1925. He was elected vice president and general manager in 1944 and was elevated to the presidency of the division in 1950. He is also a director of Borg-Warner. Rose resigned in 1953 as vice president and assistant general manager of the Warner Gear division, with which he had been associated since 1931, to represent the parent company's interests in financial and manufacturing circles in the far West. His election as vice president is coincidental with a current expansion of Borg-Warner's research, manufacturing and sales activities on the Pacific Coast. The election of **Alonzo B. Kight** as vice president of **Borg-Warner International Corporation,** export subsidiary of Borg-Warner Corporation, also has been announced. Kight has served as administrative assistant to the president since 1952. He joined Borg-Warner in 1948 as a patent attorney. Three executive promotions announced by the Atkins Saw division of Borg-Warner include **Carl J. Meister,** previously vice president, sales, named executive vice president and assistant general manager of the division; **Robert M. Zimmerman,** formerly general manager, operations, elected vice president, manufacturing; and **Howard O. Wiesen** promoted from assistant to the president to vice president, administration.

Trebor B. Morris recently joined **Chicago Pneumatic Tool Company** as chief metallurgist for the Oil Tool division, Fort Worth plant. Morris has had wide experience in oil tool metallurgy, serving previously with American Iron and Machine Works and Reed Roller Bit Company.

Trebor B. Morris

O. W. Barnett

Orville W. Barnett, manager of Nordstrom valve distribution and oil field sales for **Rockwell Manufacturing Company,** has been named assistant to the vice president, Meter and Valve division. He will move to the new Rockwell valve plant at Sulphur Springs, Texas, to promote and coordinate oil field sales and to develop a training program for Rockwell and distributor sales personnel and customer representatives. Barnett joined Rockwell in 1934. **Jack D. Bateman,** senior market analyst at Rockwell, has been named manager of market research. He succeeds **A. Clark Daugherty** who has been assigned other corporate duties in addition to maintaining over-all supervision of market research and public relations. Bateman joined Rockwell as a market analyst in 1951 after serving as sales representative for Procter & Gamble Company.

W. E. Horenburger

Kenneth R. Cowan

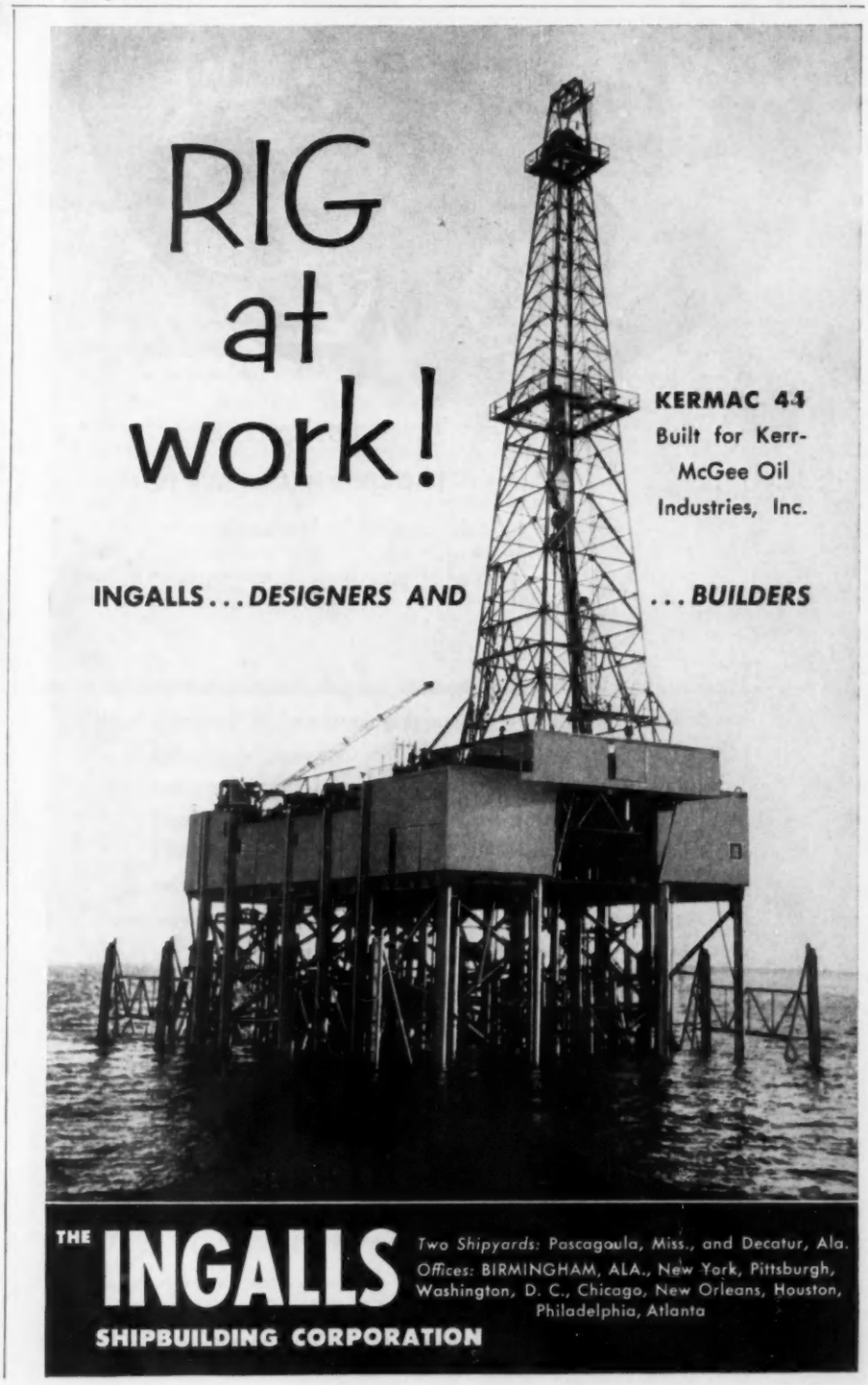
William E. Horenburger has been appointed sales manager, and **Kenneth R. Cowan,** plant manager of **Aetna Ball and Roller Bearing Company,** division of parkersburg-Aetna Corporation. Horenburger formerly was associated with Thomson Industries, Inc. Cowan recently has been with the consulting firm of Tammen and Dennision, Inc.

•

William J. Alexander, advertising manager of Johnston Pump Company of Pasadena, Calif., also has been appointed advertising manager of Emsco Manufacturing Company, and will coordinate and direct the advertising of both organizations. To consolidate the advertising of Emsco and the recently acquired Johnston Pump Company, Emsco will concentrate all advertising activities in California.

Crane to Build Suburban Plants

Ground has been broken for two new one-story buildings to house extensive research and laboratory operations for Crane Packing Company in the Chicago suburb of Morton Grove. Approximately 5000 square feet will be devoted to laboratory research and testing; and another 32,000 square feet will accommodate sales, executive and general offices. A cafeteria also will be included in the new plant.



(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

Joe Roughneck, symbolic figure of the petroleum industry, has in Lone Star Steel a dependable source of API casing, tubing and line pipe right *in his own neighborhood!* Whether Joe is still rendering rough and rugged service in the field or running the show as a president or board chairman . . he knows oil . . and pipe. He knows he can't get better pipe . . quicker . . anywhere. He likes to deal with his neighbors at Lone Star because this ultra modern, completely integrated steel mill was built especially for Joe Roughneck's convenience.

Neighbor, wherever you are, specify Lone Star and we both get a good deal!

Lone Star STEEL COMPANY

LSS

EXECUTIVE-SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 8087 • Dallas, Texas

DISTRICT SALES OFFICES
Houston, Texas | Midland, Texas | San Antonio, Texas
Tulsa, Oklahoma | Wichita Falls, Texas | Shreveport, La.

Charles P. Page, recently appointed manufacturing engineering specialist for the Distribution Assemblies department of **General Electric Company,** will be responsible for formulating and recommending new and revised manufacturing methods and processes involving development of plant layout and material handling methods. He also will handle recommendations of sources of supply for tools, dies and other facilities. Page joined General Electric in 1953. He formerly was manufacturing project engineer in the Trumbull Components department.

•

Griswold A. Price has been appointed assistant vice president—sales—Western area, for the **United States Steel Corporation.** He succeeds **Herbert J. Watt** who has retired after 43 years service as sales executive in the steel industry. Price's entire business career has been with U. S. Steel, having started as a student in the Gary Steel Works in 1919. He was appointed manager of sales in the Chicago district sales office in 1939 and then manager of the Chicago district office in 1947.

•

James C. Dendy has been appointed assistant district engineer—machinery and equipment sales and service at Greggton, Texas, for **U. S. Steel's** Oil Well Supply division. He joined Oilwell in 1953 as an engineer trainee and was transferred to Greggton in 1954. **Gorman Terrell Horton** has been named field representative at Greggton for Oilwell; **Dewey M. Clark** has been named field representative at Hobb, N. M.; and **Raymond H. Miller** has been named field representative at Medicine Lodge, Kansas. Horton was employed in 1954 at Greggton as storeman, and Clark was employed in 1947 at Odessa, Texas, as storeman. In 1953 Clark was made storeman in McCamey, Texas. Miller joined Oilwell as storeman in 1948 at El Dorado, Kansas. In 1952 he was appointed store manager at Stafford, Kansas, and in 1954, store manager at Medicine Lodge. **Lewis Y. Poland,** recently named store manager at Medicine Lodge, joined Oilwell in 1947 as storeman at Ellinwood, Kansas. In 1953 he was appointed field representative at Ellinwood, transferring in 1954 to Medicine Lodge as field representative.

•

Hosea P. Hearn and **Richard M. Hansen** were elected vice presidents of **Halliburton Oil Well Cementing Company** at a recent stockholders and directors' meeting. **Erle P. Halliburton,** founder and chairman of the company, and all other officers were reelected. Named regional vice president for the Central region was Hearn. He began as a cement truck driver in 1925 and has had field experience in Arkansas, Oklahoma, Texas, the Rocky Mountain area and California. For the past year he has been regional manager. Hansen had been coordinator of production, engineering and materials at Halliburton's Duncan plants and was named vice president in charge of manufacturing. New manager of Halliburton's Lubbock division is **William L. Hughes.** Employed by the company in 1938, he has worked in the cementing, dump bailer, bulk cement, acid and credit departments. **Joe W. Maly,** assistant division manager at Oklahoma City, is transferring to Denver to serve as manager of the Rocky Mountain division. Replacing Maly at Oklahoma City is **George S. Battles,** former customer contact representative for Halliburton's Oklahoma division.

Stuart F. Atsatt

H. J. Buttner

Fred J. Myers

E. M. Gearke

Jack Errion

Jack McCann

Stuart F. Atsatt has been appointed manager of the Chicago branch, **Enterprise Engine and Machinery Company**, subsidiary of General Metals Corporation. Atsatt formerly was district manager for the company in Minneapolis.

•

H. J. Buttner, appointed manager of engineering for the Le Roi division of **Westinghouse Air Brake Company**, has had nearly 25 years of engineering experience in design and development of high output internal combustion engines. He has held engineering management positions with Continental Motor Corporation, the Allison division of General Motors and the Packard Motor Car Company.

•

Hammond Iron Works announces the appointment of **Fred J. Myers** as district sales manager, with headquarters at Warren, Penn. He previously had been with Lukens Steel Company and Welding Engineers, Inc.

•

Baash-Ross Tool Company, Division of Joy Manufacturing Company, announced the appointment of **E. M. Gearke** as Gulf Coast area sales manager for the company. He was formerly with Trident Drilling Company in Calgary.

•

Jack McCann, who has been serving as manager of **LeTourneau-Westinghouse Company's** Washington, D.C., office, has been appointed government sales manager. In his new position, he directs activities of the department, including the Washington office. McCann joined the company in 1950 and served successively in export advertising and sales promotion positions before becoming Washington representative and manager. **Jack Errion**, former advertising promotion supervisor for the company, has been named sales promotion manager. He joined the firm in 1951.

•

Ed C. Kirby, recently appointed technical service representative for **Ideco**, one of the Dresser Industries, is well known in the Mid-Continent area, having been associated with petroleum equipment manufacturers and supplies for 30 years. With Ideco, Kirby will specialize in supplying Ideco fabriform sheaves to original manufacturers. His headquarters are in Houston.

•

Glenn O. Logan recently was promoted to division manager of the Atlantic Sales division of Cleco division of **Reed Roller Bit Company**. Logan has been with the company in the Atlanta area as a special salesman since 1948.

•

Chester J. Spacher has been named sales manager of the Chain Drive department, **Morse Chain Company**. He was formerly Ithaca district sales manager, working out of Rochester.

•

Joseph A. Scruggs, naval architect and marine engineer, has joined the staff of **R. G. LeTourneau, Inc.**, at Longview, Texas. He has been assigned project engineer for a mobile drilling platform for offshore oil exploration which LeTourneau is constructing for Zapata Offshore Company. For eight years Scruggs has been marine engineer for the Bethlehem-Sparrows Point Shipyard at Sparrows Point, Maryland.

ROBINSON

OLDEST NAME IN ORIFICE FITTINGS

Type E For Low Pressure . . .

2" to 30" A.G.A. Spec.

Where, except at Robinson, can you obtain all these features in an orifice fitting for gas or liquid flow? Extreme accuracy of measurement is yours because the Robinson orifice is always centered with the piping and sealed against leakage. Orifice plates can be changed safely and quickly (3 to 5 minutes) with no interruption in flow, no hazards or gas loss. Various sizes and pressure ranges up to 3,600 PSI, flanged or welding neck.

Type E For High Pressure . . .

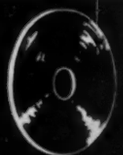
2" to 6" Pipe Size A.G.A. Spec.

Same fine metering characteristics as the standard low pressure Type E shown above, but built for 6,000 PSI with positive pressure seal which becomes tighter as the pressure increases. Safety is assured because the fitting cannot be opened until the pressure is released. Available in flanged or welding neck. Compare Robinson point-by-point and you'll choose Robinson.

SEND FOR ROBINSON CATALOG NO. 54.

ROBINSON
ORIFICE FITTING COMPANY
2830 LUGO STREET • LOS ANGELES 23, CALIF.

ORIFICE PLATES AND HOLDERS



Standardize on Robinson orifice plates regardless of the make of fittings on your lines. Robinson plates conform rigidly to A.G.A. requirements. Our 30 year reputation for building accurate orifice plates is protection you can count upon.

Another DARCOVA first!

100% NYLON COMPOSITION

DARCOVA VALVE CUPS, SEATING CUPS, AND SEATING RINGS

—long noted for outstanding performance in well pumping—are now available in 100% nylon composition for *extra* strength, *extra* life!

They are offered in the full range of precision sizes and Darcova textures that assure peak efficiency under varying conditions of depth, pressure, temperature, corrosion and abrasion.

So be sure to specify
DARCOVA
The *original* . . . and *always* the best!

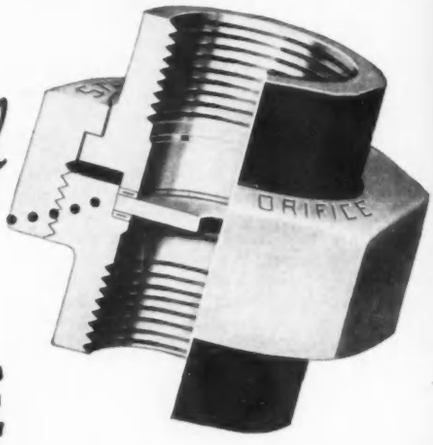
DARLING VALVE & MANUFACTURING COMPANY
DARCOVA ®
THE ORIGINAL COMPOSITION CUP
WILLIAMSPORT 28, PA.

Cat Tractor Gets Deepfreeze Outfit

Under construction by Caterpillar Tractor Company is one of 21 especially manufactured track-type tractors to be used on Rear Admiral Richard E. Byrd's coming Expedition Deepfreeze to the Antarctic to establish three observation sites. This modified Cat D8 tractor has special nine-roller track frames, 54-inch shoes and 106-inch gage. It is being equipped with a hydraulic dozer and Hyster D8D towing winch. Observing the workmen making special attachments, left to right, are: George M. Poole, technical branch manager, Bureau of Yards and Docks, and T. A. Glass and J. E. Pilor, both of Caterpillar's governmental division.

National Cylinder Gas Company has announced the promotion of **Gene Wedereit** to director of advertising for NCG and its divisions and affiliates. He has been director of advertising of The Girdler Company and Tube Turns, Louisville, Ky., since 1943. Both companies are divisions of the National Cylinder Gas Company. Wedereit formerly was vice president in charge of creative service for The E. F. Schmidt Company.

FOR THE BEST IN
Flow Control
INSIST UPON
C.M.& CO.
ORIFICE



After quick and easy installations, even in the roughest spots, these ORIFICE UNIONS will perform superbly in measuring, mixing, blending, strainer or blanking off services. Their temperature and pressure ratings are exceedingly high. They are available in forged steel, forged stainless steel and with the new tab on the orifice plate that facilitates quick identification.

OUR COMPLETE LINE OF FORGED STEEL UNIONS IS FULLY DESCRIBED IN A NEW CATALOG. WRITE FOR YOUR FREE COPY!

Clayton Mark & Company
1900 DEMPSTER STREET · EVANSTON, ILLINOIS · U.S.A.

"It's engineered to get the job done right"

The picture above shows what G. L. Fife, Jr., of G. L. Fife & Son, Natchez, Miss., means when he talks about getting a job "done right." Here, one of their Mack trucks, a six-wheel Model LMSW is moving a draw-works, compound and two motors, a combined weight of approximately 80,000 pounds.

A user of Mack trucks for the past nine years, Mr. Fife says, "I like the way our Mack LMSW eases the iron up a ramp with power to spare. Then when it gets out on the highway it operates at legal road speeds without burning up the rear end gears. It's easy to maneuver and it's dependable. In short, it's engineered to get the job done right."

Bigger drilling rigs and bigger oil field equipment are making extra demands on trucks these days. Trucking contractors in the oil fields, like G. L. Fife & Son, are proving the truth of the oft-repeated fact—Wherever You See Tough Jobs—There You'll See Macks.

They find that to get the job done right, they can't afford *not* to own Macks.

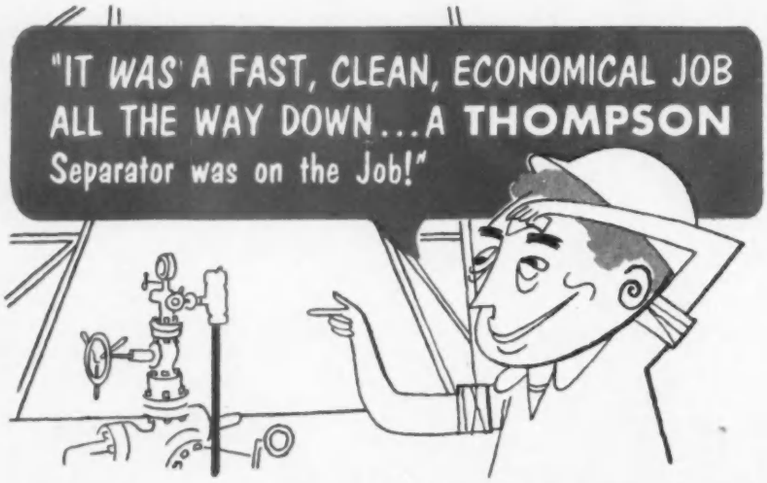
MACK TRUCKS, Empire State Building, New York 1, N. Y.

3000

Frank F. Elliott, senior vice president of sales for **Crane Company** since 1952, has been elected president and chief executive officer of the company. He succeeds **John L. Holloway**, who recently resigned as president and director. Holloway, who was elected president in 1946, will continue as a consultant to the company. Elliott is a veteran of 33 years with the organization, joining Crane in 1922 as sales engineer at the company's Los Angeles branch. He was named western district manager in 1943, a post he held until 1951 when he was elected vice president in charge of branches.

Tex-Tube Builds in Houston

New offices, shop buildings and pipe yard for Tex-Tube are now under construction on North Post Oak Road in Houston. The modern, one-story brick and glass office building has 5000 feet of floor space. Modern steel buildings behind the main office house the various shops. Also located on the 13-acre tract are two parallel crane runways and racks for pipe storage.



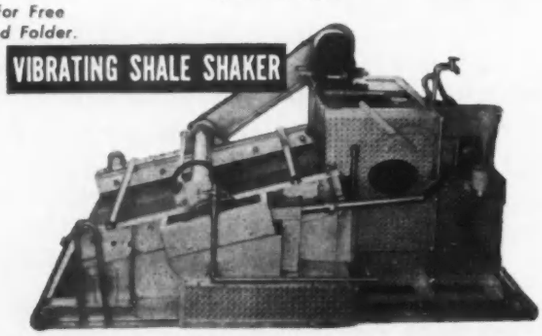
You Get a Top Job with a THOMPSON!

That's what drillers and profit-wise operators everywhere are saying. They're using the Improved **THOMPSON** Vibrating Shale Separator with Sample Machine. It's an important part of their standard equipment.

Wells are fed a steady flow of *clean mud* with a **THOMPSON** because its vibrating action effectively removes abrasives and shale from drilling muds. The Sample Machine supplies foot-by-foot specimens of formation cuttings. It's standard on all **THOMPSON** Separators unless otherwise specified.

Every **THOMPSON** Separator is field-proven. Performance, as specified, is guaranteed, economy is a reality, and its cost fits your budget.

Write for Free Illustrated Folder.



Manufacturers also of the famous THOMPSON Self-Motivating Rotating Shale Separator and Sample Machine.

THOMPSON TOOL CO.

IOWA PARK, TEXAS

SOLD THROUGH SUPPLY STORES EVERYWHERE

U. S. Steel's Oil Well Supply division changes include **M. M. Livingston**, industrial engineer at Garland, named chief industrial engineer for the facility; **Albert R. Smith** appointed district engineer—machinery equipment sales and service at Shreveport; **Charles D. Vickers** appointed field representative at Odessa, Texas; and **William B. Fisher**, formerly field representative in Canada, named store manager of the recently-opened Valleyview, Alberta, Canada store. Three appointments in West Texas announced by Oilwell include **Edward Dwayne Andrus** named field representative at Anson, Texas; **J. R. Canon** appointed field representative at Hobbs, N. M.; and **Wylie Pressly Wright, Jr.**, field representative at Hobbs, transferred to Denver City, Texas.

L. E. Wallace

Ralph H. Soape

L. E. Wallace, recently named sales manager for **Orbit Valve Company**, previously was district manager in Houston. He will be succeeded by **Ralph H. Soape**, now assistant manager. Wallace joined Orbit in 1946 as field salesman. He was appointed regional sales manager over the south Texas and Gulf Coast area in 1951. Soape joined the company in 1951 as field salesman in the Corpus Christi area.

•

J. H. Smith, East Central district sales manager, has been transferred to Detroit for **Wolverine Tube**, Division of **Calumet & Hecla, Inc.** Formerly in Dayton, Ohio, Smith will move to Wolverine's new Detroit branch office which will become headquarters for the East Central district. Replacing Smith in Dayton will be **R. B. Flynn** who will become territorial supervisor, supervising activities of Wolverine's Columbus, Ohio, and Louisville, Ky., offices. **Jack Gavigan**, formerly sales representative in Louisville, will replace Flynn in Detroit, and **Jack Sheehan** will replace Gavigan in Louisville.

Kenneth Lieber

Wesley O. Page

Kenneth Lieber has been appointed assistant vice president—sales of **United States Steel's** National Tube division. He began his business career in the Engineering department of the Pennsylvania Railroad Company in 1937, joining Consolidated Western Steel, now a division of U. S. Steel, in 1945. Since January he has been vice president in charge of engineering.

•

Jeffe L. George, Jr., has joined **P. R. Rutherford** as general manager of the Land and Exploration department. He formerly was division geologist for Sohio Petroleum Company, Gulf Coast division.

•

Wesley O. Page, who previously worked for the **George E. Failing Company** as field representative in the Grand Junction, Colo., area, has rejoined the firm's sales staff, assigned to the Houston branch. He will serve the area around San Antonio. Page has worked for several major oil companies' drilling departments and recently was with the Texas State Highway Department.

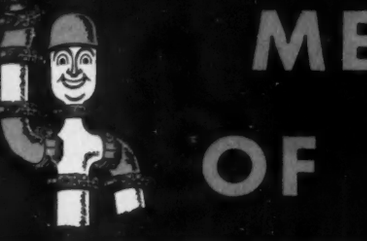
•

Technical Oil Tool Corporation has announced the following changes in the field service organization. In the Gulf Coast area, **Maurice Webb** has been transferred from Houma, La., to Lafayette and will service Lake Charles, New Iberia and Eunice. **Bobby L. Howard** has replaced Webb at Houma and Harvey, La. In the Oklahoma-Kansas area, **S. W. Stafford,** who will be located at Pratt, Kansas, will service Ellinwood, Liberal, Pratt and Russell, Kansas. **R. G. Willson,** in the West Texas-New Mexico division, will be stationed at Farmington, N. M., servicing the Farmington and Artesia, Colo., areas. In California, **William R. Webb,** working out of Bakersfield, will cover Avenal, Bakersfield, Rio Vista and Taft.

•

H. Gordon Smith, executive vice president of **United States Rubber Company,** also has been elected vice chairman of the board and chairman of the executive committee. **Chester J. Noonan,** vice president, has been elected a member of the executive committee. Smith has been with U. S. Rubber since 1917 when he joined the Planning department of the company's Detroit plant. He was elected a vice president in 1945 and a director, vice chairman of the executive committee and executive vice president in 1951. Noonan joined U. S. Rubber in 1919 as a clerk in the footwear and clothing department. Appointment of **Herbert J. Reid** as assistant general manager of the mechanical goods division also has been announced by the company. Reid was formerly factory manager of the division's Fort Wayne, Ind., plant. **Homer McCracken,** assistant factory manager, has been named to succeed Reid.

VICTAULIC METHOD OF PIPING



VICTAULIC COUPLINGS

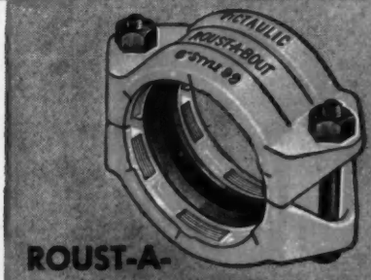
Styles 77, 77-D for standard applications. Simple, fast to install—sturdy and reliable. Sizes ¾" to 30". Style 75 Light-Weight Couplings for light duty applications. Sizes 2", 3", 4". Additional styles for cast iron, plastic and other pipes. Sizes through 60".

VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc.—to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes ¾" to 12".

VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the work in half the time. Light weight, easy to handle—operate manually or from any power drive. Automatic groove position and depth. Sizes ¾" to 8".



ROUST-A-BOUT COUPLINGS

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky — easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 8".

VICTAULIC SNAP-JOINTS

Victaulic's new boltless, speed coupling. — Style 78 — hinged into one assembly. Hand-locks for time and dollar savings. Sizes 1", 1¼", 2", 3", 4".

EASIEST WAY TO MAKE ENDS MEET

Promptly available from distributor stocks coast-to-coast. Write for NEW Victaulic Catalog-Manual 55-10G

VICTAULIC COMPANY OF AMERICA

P. O. Box 509 • Elizabeth, N. J.

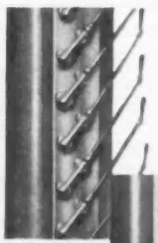
B and W
SCRATCHERS AND CENTRALIZERS

B and W Multi-Flex Scratcher

B and W Hinged Nu-Coil Scratcher

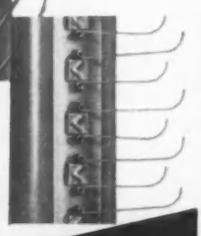
B and W Plain Stabilizer

B and W Latch-on Centralizer with Kon-Kave Bow


Multi-Flex Type

B and W Rotating Scratchers

Nu-Coil Type



For a Good Cement Job

Positive Mud Removal and Complete Cement Fill

B and W Inc.
Well Completion Specialists

GULF COAST
Box 5266
Houston 12, Texas
Phone WA-3-6603

WEST COAST
Box 3751
Los Angeles 54, Calif.
Phone DA-4-1106

9404

Ted Sandelius to Direct Tube-Kote Custom Service

Ted Sandelius has been appointed sales engineer to direct the newly-expanded Custom Coating department for Tube-Kote, Inc. Previously, Sandelius was representative with Standard Brass & Manufacturing Company serving the Gulf Coast. As director of Tube-Kote's new expanded Custom Coating department, he will serve the same area and provide industries with Tube-Kote's TK-2 plastic, Teflon plastic and other Tube-Kote plastic linings.

Ted Sandelius

The Custom Coating department gives oil field equipment manufacturers and other industries in the Gulf Coast a new service. It provides a nearby headquarters for plastic lining of such diversified items as petrochemical equipment, storing-cooking-mixing tanks of all kinds, chemical handling equipment, piping and processing equipment, valves, compressors, hydraulic units and various types of liquid carrying equipment.

BJ Stockholders Approve Merger with Borg-Warner

Byron Jackson Company stockholders approved plans for a merger with Borg-Warner Corporation at a recent meeting held at Byron Jackson's headquarters offices in Los Angeles. The merger plan provides that Borg-Warner will exchange four shares of common stock for each five shares of Byron Jackson.

Byron Jackson will retain its management and operating policies, becoming the Byron Jackson division of Borg-Warner Corporation.

Byron Jackson Company is a pioneer West Coast manufacturer established in 1872. Its principle products are oil tools, centrifugal pumps, electronic instruments and oil field industrial and rubber products. It has recently been expanding in the electronic and nuclear fields. Borg-Warner is a leading manufacturer of automotive, aircraft equipment and agricultural implement parts.

Factory Site in New Jersey Purchased by Worthington

Worthington Corporation has purchased from the Elliott Company a 15-acre factory site in the Ampere section of East Orange and Newark, N. J. The transaction also includes a dozen existing buildings, totaling over 330,000 square feet of working floor space.

The facilities will be used to accommodate two of the company's major product divisions: the manufacture of large central station air conditioning equipment and the manufacture of standard pumps.

The headquarters offices for engineering, sales, and service for Worthington's Air Conditioning and Refrigeration division will be moved to the Ampere site from the present location at Harrison, N. J., and will continue to be under the direction of M. M. Lawler, vice president.

Worthington's Standard Pump division will continue to be headed by V. de Gerbereux, general manager of the division, who also will make his headquarters at the Ampere site, along with his engineering, sales and service staffs.

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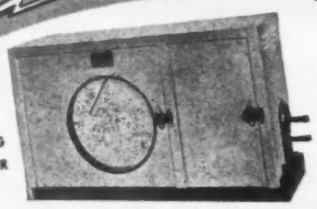
Westinghouse Air Brake Names Failing In Houston Distributor

The Houston branch of the George E. Failing Company, a subsidiary of Westinghouse Air Brake Company of Pittsburgh, has been awarded the distributor franchise for the Houston area for all products manufactured by the Industrial Products division of Westinghouse Air Brake Company of Wilmerding, Penn.

All articles manufactured by the division will be stocked and serviced by the Failing branch in Houston and repair facilities will be available. These include pneumatic control devices for rotary drilling rigs and marine vessels. Dick Miles is branch manager in Houston.

ARCCO

NOW SPECIFIC GRAVITY RECORDING OF LIQUIDS AT ANY DISTANCE



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Accurate long-distance transmission of specific gravity recordings is no longer a problem with the new Arcco-Anubis Metameter Recording and Transmitting Liquid Gravitometer. This instrument combines the mechanism of the standard Arcco Liquid Gravitometer with a metameter telemeter transmission system which records and transmits the specific gravity record to control room or other remote location. The interconnecting line may be any two-wire electrical circuit or its equivalent: private wires, telephone circuits, carrier current channels, or radio (VHF or UHF).

The range of the standard instrument is .15 or larger, but instruments with ranges of .10 or .05 can be supplied. Specific gravity charts are available for many gravity ranges, and special degree A.P.I. charts can be furnished at slight additional cost. Request Bulletin No. 111-R2B for complete details.

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SEND FOR BULLETIN No. 111R2B

Camair Sells First Plane

Fred J. McCabe of the Grolier Society was first buyer of a production model CAMAIR 480, new twin engine iarplane built by Camair at their Galveston, Texas, plant. McCabe purchased the plane through Charles Toth of Toth Aircraft and Accessories Company, Camair's first distributor, whose sales terr.tory includes Kansas, Missouri, Illinois, Oklahoma, Iowa and Nebraska. Shown in front of the plant are (left to right) William Schmidt, sales manager for Camair, Toth and McCabe.

General Electric Builds Shop To Service New York-New Jersey

General Electric will construct a multi-million dollar apparatus service shop in North Bergen, N. J., which will provide electrical maintenance facilities for New York State and New Jersey.

Designed to house the service shops operations now located in the greater New York City area, the one-story structure will include more than 132,000 square feet of factory and office floor space. With construction underway, the shop is expected to be completed early in 1956.

Williams & Wilson to Represent Kinney Manufacturing Division

The International Sales Office of The New York Air Brake Company has announced the appointment of Williams & Wilson Limited as distributors of Kinney Manufacturing division products in eastern Canada. Kinney division, located in Boston, was formed over 40 years ago as the Kinney Manufacturing Company. It became a division of New York Air Brake in 1953.

Head office of Williams & Wilson is in Montreal, Quebec, with five sales offices in Ontario and Quebec provinces at Toronto, Windsor, Ottawa, Montreal and Quebec City. Sales operations are conducted through a Machine Tool division, and Industrial Supply division and a Specialty Engineering division.

R/M Packing Division Moves Sales Offices to New Jersey

The sales headquarters of the Packing division of Raybestos-Manhattan, Inc., has been moved from Manheim, Penn., to Passaic, N. J. Located at the new address are R. B. Hazard, sales manager of the Packing division, and also of R/M Rubber Products; G. E. Horvath, chief engineer; W. B. Woodring, sales engineer; and J. McKinlay, special representative of the division.

National Supply Moves by Truck

Three sections of a National Supply Company oil field supply store are shown at Estevan, Saskatchewan, Canada, after a 55-mile move by truck from a previous location at Weyburn. The complete building, when assembled, is 36 feet wide and 50 feet deep, including sales room, office and warehouse space. Office furniture and supplies, as well as some of the merchandise, were left in place during the move. The store was in operation in Estevan four days after it closed in Weyburn.

Jet Lube, Inc. Appoints Oklahoma-Texas Distributor

Jet-Lube, Inc. has announced the appointment of Howard G. Crider as distributor of Jet-Lube oil field lubricants in the Ardmore, Okla., and Wichita Falls-Sherman, Texas, area. Crider will maintain stocks of Jet-Lube at 625 14th N.W., Ardmore. Jet-Lube thread compounds, plug valve lubricants and other oil field specialties are sold exclusively through supply stores.

Howard G. Crider

Baroid Division Establishes New Texas Gulf Coast Area

Baroid Division, National Lead Company, announces an expanded sales and service organization in the Texas Gulf Coast Area, with the section designated as a separate company area operating from headquarters in Houston. Alan C. Cramer, appointed manager of the Texas Gulf Coast area, has been with Baroid over 20 years, working in the Mid-Continent and Gulf Coast. Prior to his appointment, he was assistant manager of the Gulf Coast division.

Van der Horst Corporation Purchases Chicago Plant Site

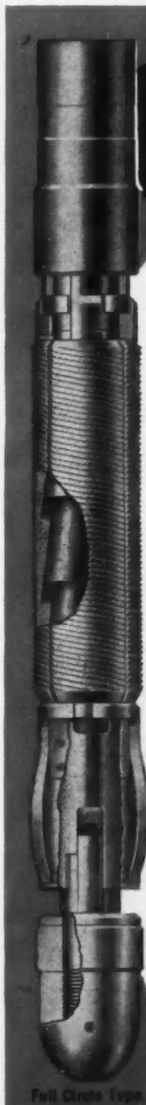
Plans to establish plant facilities on industrial property located on South Shields Avenue in Chicago has been announced by the Van der Horst Corporation. The property, recently purchased, consists of 37,000 square feet of manufacturing facilities and 15,000 square feet of yard space. Initial installations will provide for a 48,000 ampere hour plating capacity. An increased demand in the midwest for the company's patented Porus-Krome process necessitated establishment of the new plant which is expected to be in production in 1956.

Installation of Giant Press Complete at CF&I Steel Plant

Installation has been completed on the the 3000-ton "pushthrough" press, one of the largest and fastest in the world, now in production at The Colorado Fuel and Iron Corporation's Wickwire Spencer Steel plant at Claymont, Del. Capable of producing heads up to ten feet in diameter, it has the greatest head-pressing capacity of any press in the U. S. It is capable of exerting a maximum force of 6 million pounds.

Specially designed for CF&I by the Verson Allsteel Press Company in Chicago, the press stands 68 feet from top to bottom of pit.

After the pressing operation, the fin-



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Offer Many Outstanding Advantages

SECURE ENGAGEMENT– Comparisons show that this Spear has from 35% to 45% more useful slip engagement area than any other spear on the market today! There is no loss of engagement regardless of the degree of the upward pull and regardless of the intensity of the jarring blows. On numerous actual jobs, in conjunction with hydraulic pulling tools and jars, pipe has been pulled and jarred in two below the Full Circle Type Bowen Releasing Spear with no distortion at the point of engagement.

POSITIVE RELEASE– Full Circle Type Bowen Releasing Spears provide means for hanging and supporting the Full Circle Slips in their uppermost position relative to the spear body. Full Circle Spears can be engaged with and released from a fish indefinitely without being withdrawn from the hole. The releasing mechanism is unaffected by excessive pulling strains, terrific jarring blows, and adverse well conditions.

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All Full Circle Type Bowen Releasing Spears for Casing are engineered to provide greater tensile strengths than the tensile strengths of the pipe sizes that they engage.

The Full Circle Slips encompass so much of the inner area of the fish that it is virtually impossible for any junk to fall alongside and foul the mechanism of the Spear. The Full Circle Slips are designed to collapse below the outside diameter of the Safety Ring or the Safety Ring Pack-off. This feature insures the Spear ability to release from any fish that it has penetrated.

Available in tubing and drill pipe sizes as well as in casing sizes.

Write for descriptive literature

ECONOMY – Because Full Circle Spears do not distort the fish, there is no movement under strain of the spear within the fish and the Full Circle Slips can be subjected to great pulling and jarring strains with no wear whatever. Pipe and liners salvaged by Full Circle Spears are more usable because they are neither split nor distorted. Another time-saving feature is the fact that slips can be changed without removing the Nut from the Body.

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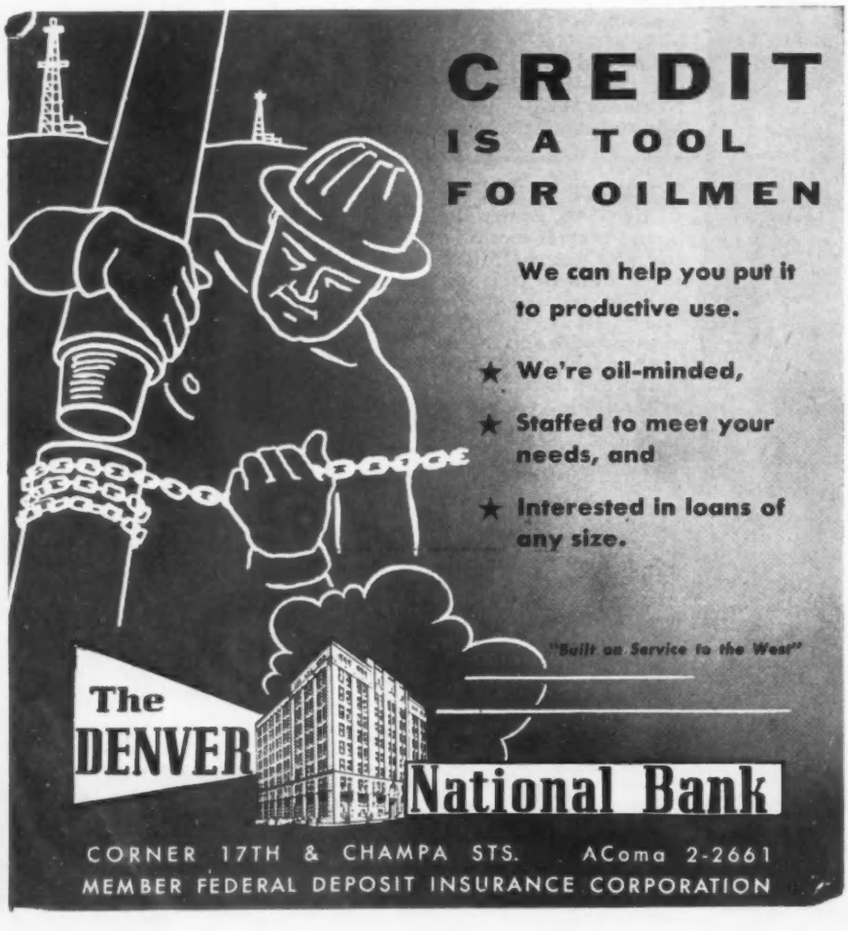
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ished heads are carried from the pit to ground level by an automatic conveyor. This feature was designed to simplify and speed up handling, making the entire operation completely automatic from loading to finishing.

LeBus Executive to Establish Distributorships in Europe

Frank LeBus, Jr. sailed recently for Europe to set up distributors for products manufactured and sold by LeBus Rotary Tool Works and LeBus International Engineers, Ltd., of Longview, Texas. He will tour France, Germany, Holland and England.

Porter Buys Electronics Firm; Eseco Becomes 13th Division

The Electric Service Engineering Company has been purchased by H. K. Porter Company, Inc. Eseco, trade name for Electric Service, specializes in design and manufacture of complex electrical and electronic devices used in heavy industry and certain government departments. It will be known as the Eseco Division, H. K. Porter Company, Inc., and is the thirteenth within the Porter organization.

Present management of Eseco will continue with the new division. R. J. Cadorette, former president, will be executive vice president in charge of operations. B. F. Pfeifer and R. W. Dixon will be vice presidents in charge of sales and engineering, respectively.

Eseco's general offices and Engineering department are in Joliet, Ill., with all manufacturing done in its Lockport, Ill., plant. Porter has announced plans for expansion of the new division's manufacturing facilities as well as a step-up in research and development programs.

Security Engineering Division Opens New Office in Louisiana

Security Engineering Division, one of the Dresser Industries, announces the opening of a new division and district office and warehouse at Lafayette, La., to expand service and warehouse facilities in the Louisiana area. The new building will house offices of the Louisiana division manager, district manager, office manager and the sales and field service staff.

Cummins Names Distributor For Territory of Alaska

The appointment of a Cummins distributor for the entire territory of Alaska has been announced by Cummins Engine Company, Inc. President of the firm, Cummins Diesel Sales of Alaska, Inc., is R. B. Newell, former vice president of Cummins Diesel Sales of Washington.

Headquarters for the new service and sales organization will be in Anchorage, with branches in Ketchikan and Seattle.

Dale Ungerecht, former service manager of Cummins Diesel Sales of Washington, has been named Anchorage manager, and Don Nafziger, manager of the Ketchikan branch.

Lane-Wells Opens New Branch In El Dorado, Arkansas

To serve the fields in Union County, Arkansas, Lane-Wells Company has opened a new branch in El Dorado under the direction of Burt R. Brashier, veteran in oil field service. Wyatt J. Russell also will staff the new branch.

Kiker Placed in Charge Of New Bovaird Office

James Kiker, former Bovaird sales representative at Midland, Texas, has been placed in charge of the company's Rocky Mountain area, with headquarters in a new office recently opened in Denver.

James Kiker

Kiker also will represent The Bomud Company, a join operation of The Bovaird Supply Company and Mud Products, Inc. in the Julesburg Basin, which has been handling Baroid products since 1951.

Prior to joining Bovaird seven years ago, Kiker had many years' experience in field operations. With Bovaird, he has been stationed at Duncan, Okla.; Snyder, Odessa and Midland, Texas.

John Grubb Heads Cameron's New International Division

Cameron Iron Works, Inc. has announced the appointment of John Grubb as manager of the newly-formed International division. The new division is comprised of the present Cameron Iron Works of Canada, Ltd., the British Oilfield Equipment Company, Ltd., in England, the Cameron Export Division in New York City and all other manufacturing and sales offices outside the U. S. Further licensing of firms outside the U. S. to manufacture Cameron products also will be handled by the International division. Grubb was formerly director and general manager of National Supply Company of Venezuela.

John Grubb

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, and JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF WORLD OIL, published monthly at Houston, Texas for October, 1955.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher Ray L. Dudley, 3371 Chevy Chase, Houston, Texas; Editor and Editorial Director, Warren L. Baker, 5324 Cherokee, Houston, Texas; Managing Editor, Wallace Fitzgerald, 1514 Hewitt Drive, Houston, Texas; Business Manager and Executive Vice Pres., A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. The owner is The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; June Wooden Dudley Bliss—Trustee, Houston, Texas; A. L. Burns, Houston, Texas; Grace Carter, Dallas, Texas; Margaret D. Cashman, Houston, Texas; P. Stinson Dudley, Eldorado, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Houston, Texas; Wm. V. Gross, Fort Davis, Texas; Carolyn Dodson Keeble, Abilene, Texas; Anita S. Lane, Houston, Texas; Charles H. Lane, Houston, Texas; James William Nelson, Baytown, Texas; Tom W. Nelson, Houston, Texas; Walter Gage Sterling, Trustee, Houston, Texas; O. R. Waller, Chicago, Illinois; Patricia McFarland Windham, Austin, Texas.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: NONE.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

Business Manager & Executive Vice President.
A. L. BURNS

Sworn to and subscribed before me this 15th day of September, 1955.

P. J. AUCOIN.
(Seal) Notary Public in and for Harris County, Texas.
(My commission expires June 1, 1957.)

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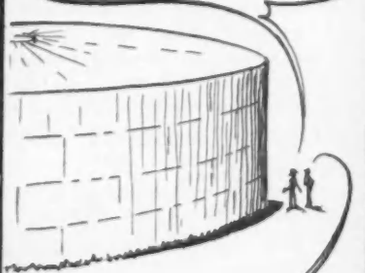

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Read it All

Boss "What are you doing here? Didn't you read the letter I sent you?"

Office Boy. "Yes sir, I read it inside and outside. On the inside it said, 'You are fired,' and on the outside it said, 'Return in five days.' So here I am."

Always Will Be!

"Mother," protested the youngest son, "you've given Jimmy a bigger helping of pudding than me!"

"But, honey, he's a bigger boy than you are."

"Well, gee whiz," came the reply, "He always will be at this rate."

Silly Question

The harassed driver was busily engaged with a spade in the mud beside his car when a stranger hailed him.

"Stuck in the mud?" asked the stranger.

"Oh, no," exclaimed the driver cheerfully. "My motor just died and I'm digging a grave for it."

Touche!

Father: "When I was a young man girls knew how to blush."

Daughter: "What was it you used to say to them?"

April 15

Wife: "Dear, this suit is quite shabby. Shall I give it away?"

Husband: "Good gosh, no! That's the suit I wear when I go to protest my income tax."

In the Clear

Little Joseph, aged seven, raised his right hand.

"Teacher," he asked, "suppose a man promised a girl a penthouse, a yacht, a limousine, and marriage. Can she sue him for breach of promise?"

The teacher shook her head.

"No," she replied, "breach of promise cases are now outlawed in this state."

Little Herbert, aged eight, who sat next to Joseph, leaned over.

"There you are pal," he said. "I told you that you had nothing to worry about."

Busy Body

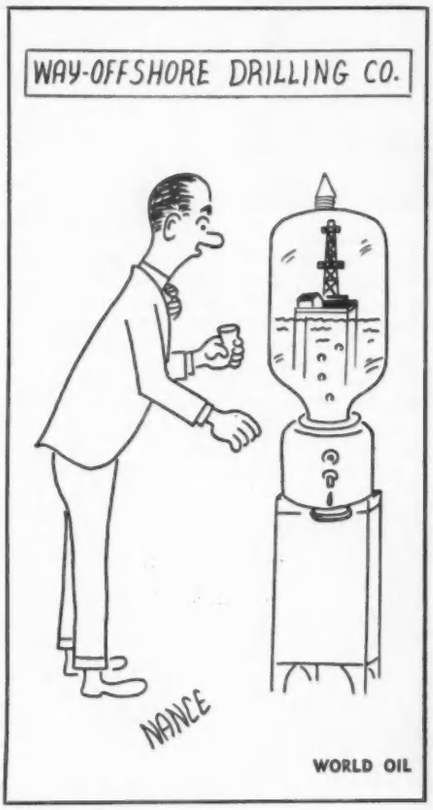
"Why are you rushing about so on such a hot day?"

"I'm trying to get something for my husband."

"Had any offers?"

Reward

O'Brien was determined to pass his favorite saloon on his way home. As he neared it he became somewhat shaky but gathering his courage he managed to make it by. After going about 50 yards he turned, saying to himself: "Well done, O'Brien, me lad. Come back and I'll treat ye."



Can Be Done

Bud: "But, Dad, don't you believe two can live as cheaply as one?"

Dad: "Sure, your mother and I are living as cheaply as you."

Dressed the Part

As the choir marched to their places, clad in white robes, a young boy in the back of the church piped up:

"Mommy, are they all going to get haircuts?"

Re-Trod

Husband, pacing the floor with howling baby, to wife: "Isn't it about time to take him back to the doctor for a thousand-mile check-up?"

Hold On!

Hubby went out with the boys one night, and before he realized it, the morning of the next day had dawned. He hesitated to go home and tell his wife, but he finally hit upon an idea.

He called up his wife, and when she answered, he shouted, "I'm back! Don't pay the ransom!"

Terrible

"Doctor, you've got to give my husband something to keep him from snoring."

"Pretty bad, eh?"

"Bad, why it keeps the whole congregation awake."

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In a shallow well in Oklahoma the McCullough Radiation Well Log picked up 23′ of pay that had been missed by an electric log.

The electric log had picked a hard limestone as the pay zone. 5½" O.D., 14 lb. casing was set to bottom. Limestone formation was perforated and found dry. Then McCullough was called to run a Gamma Ray Log. At approximately 1100′, and just below the hard limestone, the McCullough Log picked up 23′ of shaley pay sand. This entire productive zone had been missed by the electric log.

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Efficiency of McCullough Services Saves Operator Valuable Rig Time

Only 7½ hours were required to log, perforate and set a packer in this Texas well.

5½" O.D., 17 lb. casing was cemented at 7716′. Well was logged by McCullough from 7716′ to 5000′, obtaining gamma ray and neutron curves and recording a simultaneous collar log. Twenty McCullough Standard Casing Glass Jets, four per foot, were shot in the interval from 7482′ to 7487′. This was followed by setting a production packer at 6410′.

In this series of operations there was no delay of any kind — a tribute to the efficiency of McCullough tools and instruments and to the skill of McCullough service crews.

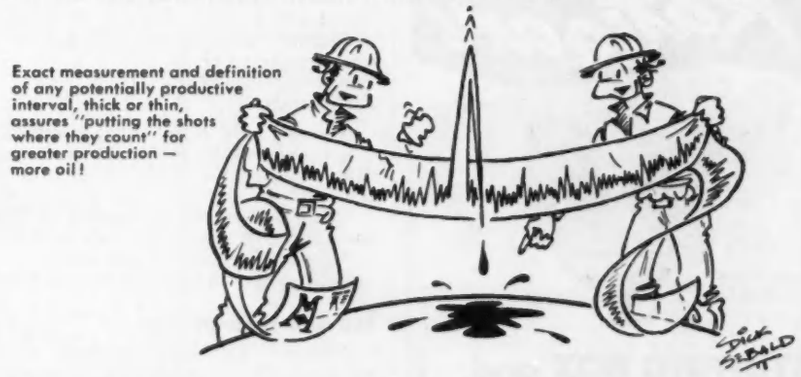
$2,433.21 SAVED

Accuracy of McCullough Radiation Well Log Prevents Wasting 390 Perforating Shots in Non-productive Shale Zones... Helps Increase Production 178 B/D

The decision to run a McCullough Radiation Well Log was worth $2,433.21 to this California operator. 390 shots would have been wasted in dry shales except for the discovery of a ten-foot error in electric log measurements.

Well had been bottomed at 11,237′ and the electric log was run in open hole. A 5½" O.D., 23 lb. slotted liner was set through the productive interval. Well was put on production and slowly settled down to 22 barrels per day.

Operator decided to perforate liner to attempt to increase production. It was known that there were eight zones separated by shale beds to be perforated. A McCullough Radiation Well Log was run to exactly locate these zones and to check previous measurements. When correlated with the old electric log it was found that there had been a ten-foot error in depth measurement.



Exact measurement and definition of any potentially productive interval, thick or thin, assures "putting the shots where they count" for greater production — more oil!

The eight zones were perforated with a total of 1332 shots, four holes per foot, from the detailed data provided by the McCullough Log. 660 of these were ½" improved Ogival Bullets fired by 3½" O.D., McCullough M-3 guns, 2 holes per foot. The remaining 672 shots were fired by McCullough Standard Casing Glass Jets with Steel Strip Carriers, 2 holes per foot.

Production increased from 22 to 200 barrels of oil per day.

This job particularly emphasizes the extreme value of the accuracy and efficiency of the McCullough Radiation Well Log to the operator. Engineers of this company estimated that, had the well been shot by the old electric log measurements, 390 of the 1332 shots would have been placed in the non-productive shale beds separating the pay zones. At prevailing prices this would have meant a loss of $2,433.21 because of wasted shots. In addition the resulting production would have been considerably lower because of improper coverage of the eight zones.

It always pays to run a McCullough Radiation Well Log before perforating.

McCullough® TOOL COMPANY

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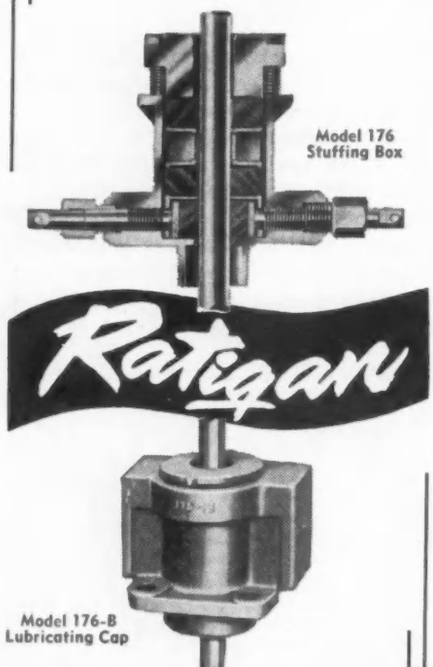
Continuous Lubrication of Polished Rod
KEEPS
Operating Costs
DOWN



STUFFING BOX and LUBRICATING CAP

The Ratigan self-oiling Stuffing Box lubricates the polished rod when the well is not heading, and the Ratigan Lubricating Cap lubricates the polished rod when the flow of oil in the tubing is retarded.

This continuous lubrication provides the polished rod with a permanent thin film of oil which assures smooth operation and eliminates scoring and undue wear of the packing in the stuffing box. This Ratigan combination is made for 1⅛" and 1¼"; and 1½" polished rods.

SOLD THROUGH LEADING SUPPLY STORES

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Do-It-Yourself

Hotel clerk to prospective guest: "I'm sorry, but we don't have room service."

Guest: "Oh, that's all right."

Clerk: "You'll have to make your own bed."

Guest: "That's all right."

Clerk: "You'll find hammer, saw, lumber, and nails in the back room."

He Can Wait

Doctor: "I can't find any cause for your complaint; I think it's due to drinking."

Patient: "OK, I'll come back some time when you're sober."

A Smash

A young lady, telephoning a music store, was connected by mistake with a garage. "Do you have 'Two Red Lips and Seven Kisses'?" she asked.

"No," answered the garage. "But we have two tom cats and seven kittens."

"Is that a record?" she asked.

"Well," said the garage, "we think it is."

No Consideration

Tenant: "The people upstairs are very annoying. Last night they stomped and banged on the floor until after midnight."

Landlord: "Did they wake you?"

Tenant: "No, luckily I was up—playing my tuba."

With Reservations

An old Negro preacher wound up a long sermon on the woes of this world, with the following "Use me, O Lord, use me in Thy work—'specially in an advisory capacity."

Rest a Bit

Victims of an accident in Scotland were still lying about the road. Along came a native and said to a man lying on his back:

"Has the insurance man been 'roon yet?"

"No," was the reply.

"Ah, weel, I'll just lie doon aside ye," said the Scot.

Come On, Son

Mrs. Gotrich (to caller): "Yes, our little Henry is wonderfully smart in school."

Caller: "What is he studying?"

Mrs. G.: "He's studying French and Spanish and Algebra. Henry, say 'Good morning' to the lady in algebra."

Just Extra Trouble

"Wouldn't it be a good idea to wipe off the windshield?" asked the anxious passenger.

"Not worth the bother," replied the driver cheerfully. "I left my glasses at home."

Who Else?

Voice over telephone: "Hello, Miss Smith, Johnny won't be at school today. He's not feeling well."

Miss Smith: "Who is this?"

Voice: "What do you mean who is this? This is my daddy!"

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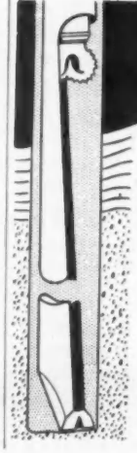
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Extra length below ring allows greater accuracy in directional settings. Also provides more space for shear pin.

To clean hole of cuttings and cavings—and eliminate extra runs—Shipco Circulating Whipstock is circulated to bottom hole.

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the new basic material, all in one piece (including channels), not welded, riveted or expanded in steel or aluminum, in standard sizes and gauges. Safety GRIP-STRUT presents an open space, in a diamond pattern, in excess of 55% of the area for ready access of light and air and gives a positive NON-SKID footing in all directions. Ideal for work platforms, stair and ladder steps, flooring, balconies, catwalks, machinery guards, fire escapes and for original equipment safety treads.

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Flooring

Machine Guards

Balconies

Important Safety Features

- ★ Fire proof
- ★ Slip proof
- ★ Maximum strength
- ★ Minimum weight
- ★ Easy to stand on
- ★ Cool in summer — warm in winter

Big Economy Features

- ★ For balconies—no extra light needed below—no extra heat.
- ★ No extra supports necessary—channels are integral part of the material
- ★ No secondary sprinkler heads needed
- ★ Self-cleaning
- ★ Cut and installed like lumber by your own maintenance force
- ★ Low in original cost

Distributors in all principal cities. Consult yellow pages in phone book under "GRATING."

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aids you in *finding oil* while the well is drilling!

FREE—new, pocket-size Drilling Rate Scale on clear acetate. Saves you time in computing charts. Available now from your Geolograph Service Man.

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NEW MODEL Series 53 CURTIN CENTRIFUGES

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Aluminum castings reduce weight one-third to approximately 5-1/4 lbs. . . . Diameter of drive shaft increased from 7/16" to 1/2" for added strength . . . Gear train redesigned for more efficient operation . . . Both 15 cc and 100 cc sizes use the same crank . . . Spindle shaft ball bearing mounted, easier to turn . . . Drive shaft of corrosion resistant stainless steel . . . Spindle of corrosion resistant stainless steel.

Write for bulletin 53

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TUBING BLOCK

With Locking Duplex
Swivel Hook

saves TIME
TIME *spells*
M-O-N-E-Y

Extremely short overall length, extra weight, extra balance for fast, true falls.

Widespread duplex hook for easy elevator operation, locks in six positions.

Completely streamlined. No projections. Capacities 25 to 100 tons.

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Box 2496 Tulsa, Oklahoma

WORLD OIL

"And I thought geology was a white collar job!"

Substitute

Night watchman: "Young man, are you going to kiss that girl?"

Student: "No, sir."

Night watchman: "Well, then, hold my lantern."

In That Case

A feminine passenger had boarded the bus after the lights had gone out. A tall man standing near her asked if he could help her find a strap.

"Thank you," she replied, "but I have already found one."

"Then I wonder if you would mind letting go of my necktie?"

Any More Questions?

Prof: Young man in the back of the room, what was the date of the signing of the Declaration of Independence?

"Dunno."

Prof: Let's try another. Who was Tom Paine?

"Dunno."

Prof: Well, well, I assigned these questions last Thursday. What were you doing last night?

"Out with some of the boys."

Prof: You mean to stand there and tell me that. How do you expect to pass this term?

"I dunno, Bud. I just came to fix the steam pipes."

Pretty Close

Neighbor: Did the doctor find out what you had?

Man: Very nearly.

Neighbor: What do you mean, very nearly?

Man: Well, I had eleven dollars and he charged me ten.

What'll You Have?

Tourist: (In Village Store) Whaddya got in the shape of automobile tires?

Clerk: Funeral wreaths, life preservers, invalid cushions and doughnuts.

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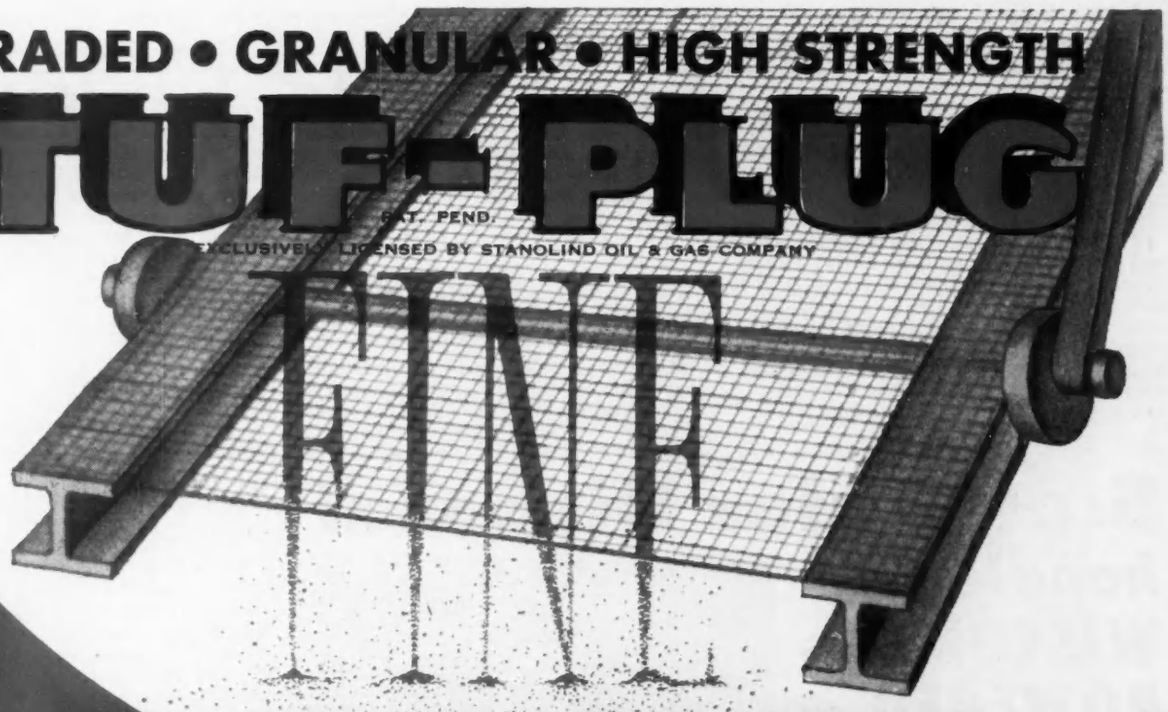

THROUGH THE SHAKER SCREEN

... engineered for lost circulation control

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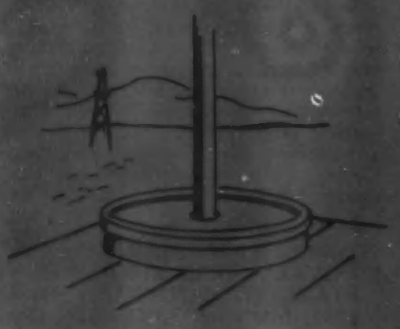
... and friction reduction



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DRILL PIPE TORQUE REDUCED MORE THAN 65% IN THE FIELD! To a drilling fluid already containing diesel oil and graphite, the addition of 1 pound of Tuf-Plug Fine per barrel further reduced drill pipe torque from 3 turns to less than 1 turn.

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BRANCHES: MIDLAND, OKLAHOMA CITY, CORPUS CHRISTI, NEW ORLEANS, LAFAYETTE, LA., CASPER

New Books, Maps and Movies

PROCEEDINGS OF THE SECOND ANNUAL WEST TEXAS OIL LIFTING SHORT COURSE. Department of Petroleum Engineering, Texas Technological College, Lubbock. $3.50

Thirty-one papers presented at the second annual West Texas Oil Lifting Short Course held recently at Texas Technological College have been compiled in book form. One of the most complete symposiums on the subject to be released to the industry, the illustrated book was prepared by the Publications Committee which included Professor W. L. Ducker, head of the Department of Petroleum Engineering; Rex Brown, Southwestern Public Service Company and E. D. Anderson, Lone Star Gas Company.

•

1955 OCCUPATIONAL SAFETY SERVICES GUIDE, National Safety Council, 425 North Michigan Avenue, Chicago 11.

The 1955 guide provides company safety directors with a complete catalog of accident prevention aids available from the National Safety Council. Listing Council periodicals, newsletters and complete library of technical and administrative publications covering all phases of occupational accident prevention, the guide also includes information on subjects covered in the basic and advanced courses of the Council's Safety Training Institute.

To assist the foreman, the service guide offers a monthly magazine, training films that show supervisors how to use basic human traits in building a better safety program and several hundred made-to-order five-minute safety talks. A full line of posters, films and booklets also are available.

•

MAP OF WILLOW BUNCH AREA, Surveys Branch, Department of Natural Resources, Administration Building, Regina, Saskatchewan. 25 cents for each half.

A new large-scale map of the Willowbunch area has been produced by the Federal Government with the cooperation of the Saskatchewan Natural Resources department's Surveys Branch. On a scale of one to 50,000, the map shows lakes, dams, creeks, trails, roads, railroads, powerlines, section lines, treed areas, location of farm houses and main buildings.

The map is in two sections, Willowbunch east and Willowbunch west. The east half represents an area six miles east and west of the town of Willowbunch and about ten miles north and south. The west half takes in an area ten miles east and ten miles north and south of the hamlet of Scout Lake. The maps are contoured representing every 25 foot change in elevation of the terrain.

•

MAP OF REGINA AREA, Surveys Branch, Department of Natural Resources, Administration Building, Regina, Saskatchewan. 25 cents.

A new map of the Regina area is now available on a scale of one to 250,000 or approximately four miles to the inch. Published by the Dominion Government, in cooperation with Surveys Branch of the Provincial department, the map is a replacement for former Regina map now obsolete.

In addition to highways, roads, railroads, settlements and location of rural schools, water features are shown in detail. Section and township lines are shown with differences in elevation of terrain represented by contour lines at 100 foot vertical intervals. The area represented is a rectangle extending 33 miles east of Regina, 20 miles west of Moose Jaw and about 35 miles north and south of Regina.

•

SUMMARY OF SECONDARY RECOVERY OPERATIONS IN THE STATE OF LOUISIANA DURING 1953, Interstate Oil Compact Commission, Box 3127, Oklahoma City.

Prepared by the Secondary Recovery Committee for Louisiana, the report estimates that recovery from the 48 gas injection projects, water injection projects, combination projects and cycling projects in Louisiana will amount to 308,941,530 barrels. The publication includes nine pages of tables giving statistical information on projects in Louisiana during 1953, as well as graphs of the more important operations.

Salt Water Disposal
handled by
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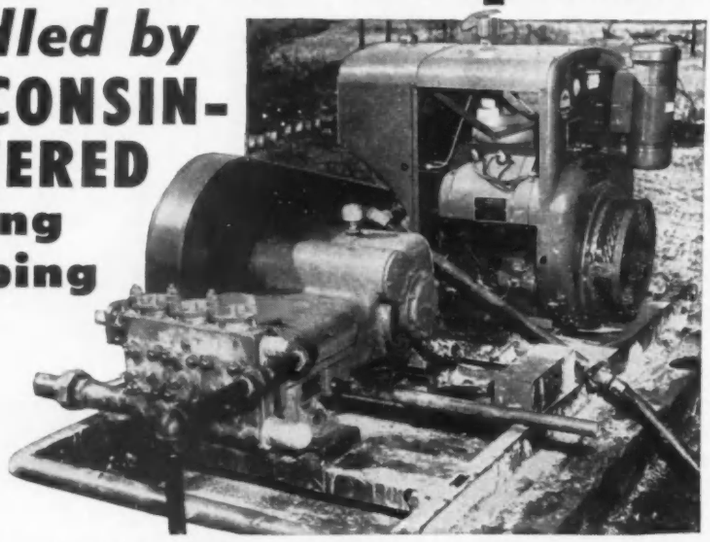

The problem of getting rid of salt water after it has been separated from the oil, without polluting surrounding land, streams or endangering livestock, has been successfully solved with this heavy-duty pumping unit.

This specially designed pump, made of special materials, best suited to this type of operation, will handle 1200 barrels of oil field brine per day at 1,000 lbs. pressure, forcing the water back into the porous formation. This unit is being used by leading oil producers and is giving a very good account of itself, according to reports from the field.

A heavy-duty V-type 4-cylinder Wisconsin Air-Cooled Engine provides the steady-going, completely dependable power that keeps the pumping unit going day in and day out, with an absolute minimum of human attention and servicing. Tapered roller bearings at both ends of the crankshaft carry the load smoothly and provide fullest protection against bearing failure. Extremely efficient AIR-COOLING solves the cooling problem under all weather conditions, from sub-zero to 140° F.

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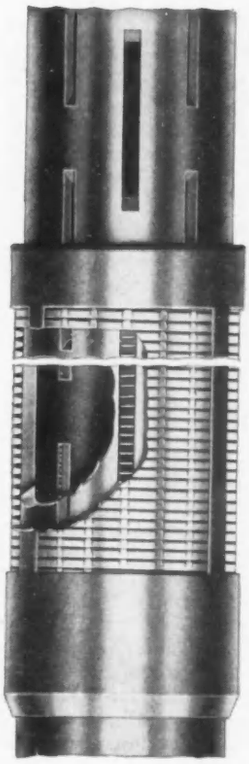


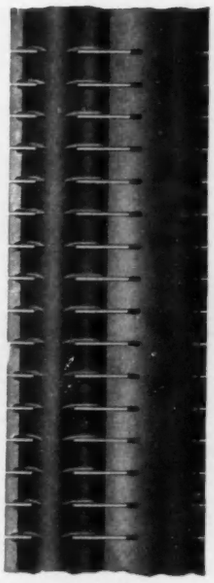
A SUPERIOR SCREEN FURNISHED IN A FULL RANGE OF SLOT GAUGES

With Emsco, the manufacture of slotted screen pipe is serious business. Our shop is equipped with machines designed especially for this purpose . . . machines that produce high quality slotted screen pipe, with slots ranging from .010 to .100 or larger if required.

We're proud of our facilities for producing this full range of slotted pipe. We're proud, also, of the record established by Emsco Slotted Pipe in wells all over the world. It retains 80% to 85% of the original collapse strength of the pipe . . . it may be spudded or rotated reasonably without damage . . . may be easily cut and pulled . . . and its V-shaped slots provide maximum drainage with minimum clogging. It's furnished, of course, in all popular sizes of pipe, to length as specified.

Emsco also manufactures "Vertical Slotted" Wire Wrapped Screen, with slotted openings that stay open longer, provide more drainage area per foot and retain 25% more strength than pipe with drilled holes with equal area.

For full information on Emsco "Slotted" and "Wire Wrapped" Screen Pipe, write for a copy of our latest catalog.



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Export Representative: Val R. Wittich, Jr., Inc., 30 Rockefeller Plaza, New York 20, N. Y.

Seeco-Mul Chemical Properties

Seeco-Mul is the dried, flaked form of so-called "crude floating soap," a compound of the sodium salts of abietic, linoleic, and oleic acids together with quantities of wood tannins and lignins.

Seeco-Mul effectively disperses the oil in emulsion muds; it emulsifies either Diesel or crude oil in either sodium or limed type systems.

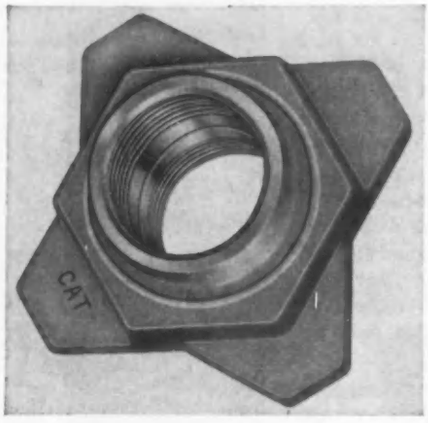
The chemical nature of the principal active compounds affords a very high hydrophile-lipophile balance value of superior effectiveness in solubilizing oil in water. Seeco-Mul also has appreciable lubricating properties in itself which augment the desired lubricating qualities of emulsion muds. It has excellent properties for maintaining minimum viscosities in a system, and in many cases has been used as the sole viscosity control agent in the emulsion. Seeco-Mul also contains sufficient quantities of inorganic salts which make the emulsion compatible with routine contaminants in the system. It is especially stable at high temperatures and pressures, it is readily soluble in cold water, and no special equipment nor instructions are necessary to use Seeco-Mul in a system.

Your mud dealer will be glad to tell you about many more features, or write to us for literature and a lab sample. There is no obligation, of course. Crossett Chemical Company, Crossett, Arkansas.

Seeco-Mul makes a good mud better. . . and cost less

What's New In Equipment

Drilling • Production • Exploration



Lug Nut Union

Catawissa Valve & Fittings Company has introduced a new four-lug lug nut union which incorporates an exclusive combination of both lug and hexagonal shaped nuts with regular or double-start Acme threads, for fast make or break with either a hammer or wrench. The lug nut design provides a straight, flat striking surface that eliminates chance of a damaging, glancing hammer blow.

The new lug nut unions are made with Catawissa's Perfect Seal seat design and 3-to-1 safety factor. They are hot forged from solid steel bars, conforming to ASTM Spec. A-105, grade 2.

(This item supplements Catawissa Valve & Fittings Company data on Pages 1152-1153 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Power Take-Off

A new model power take-off designed to meet the demands of modern drilling equipment has been announced by the George E. Failing Company, subsidiary of Westinghouse Air Brake Company. Although basically similar in design to the older model power take-off, the new model packs almost twice the rated horsepower capacity and has a greater safety factor. It is recommended for use with all drills equipped with air compressors and for drills using a 6 by 8 pump.

(This item supplements George E. Failing Company data on Pages 1557-1580 of the Composite Catalog, 20th Edition.)

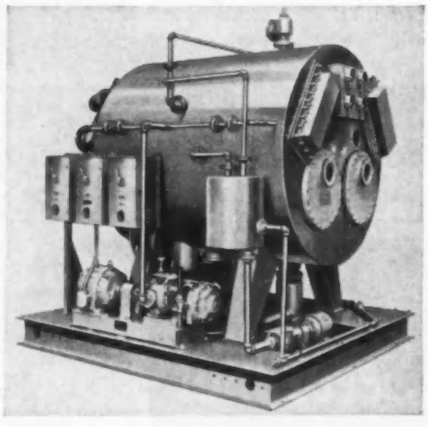
For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Logging Instruments

Perforating Guns Atlas Corporation has developed a new line of small-diameter instruments for simultaneously recording their Gamma Ray, Neutron/Neutron and Collar logs on a single trip in the hole. The new logging instruments are available in three diameters: 1-1/16 inches, 1¾ inches and 2 inches, the latter for extremely high pressures. Thirteen feet long, they are as rugged and stable as PGAC's regular 3⅜-inch OD simultaneous radiation instruments.

(This item supplements Perforating Guns Atlas Corporation data on Pages 4138-4143 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E3** on Readers Service Card, last page this issue.



Waste-Heat Evaporator

Pure, portable water is now produced from sea water, at practically no operating cost, with a unique installation on a new oil-drilling tender. Designed and built by the Levingston Shipbuilding Company, the offshore tender, "Jack Cleverly," uses waste heat from the mud pump diesel engines to produce distilled water for drinking, mud make-up and other purposes.

Using a completely new type of Clever-Brooks waste-heat evaporator, exhaust heat from the engines is transmitted through heat exchangers charged with sea water. The sea water is flashed into a vacuum chamber, and the resulting steam is then condensed on cooling coils as distilled water. Capacity of this installation is 300 gallons per hour, and similar units are now being built with larger capacities.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Bleeder Plug

Thornhill-Craver Company has announced a new feature for Unibolt products, the Plug-Lok, which provides a convenient bleeder plug which does not interfere with or prevent use of a pressure gauge. It is optional on all Unibolt products.

(This item supplements Thornhill-Craver Company, Inc., Unibolt Division, data on Pages 4849-4876 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Swivel Joint

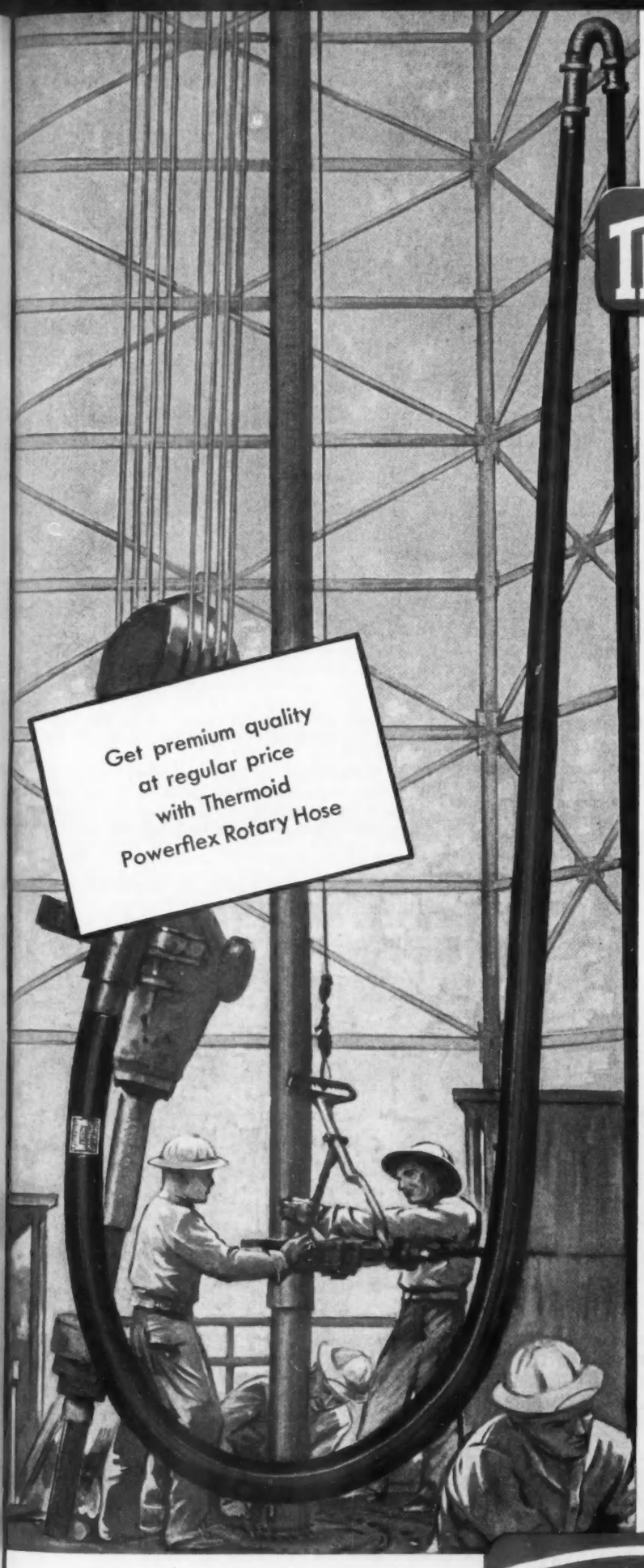
The Emsco Swivel-Ette, a new small swivel joint, is available in two styles—one for free, easy turning and the other with a drag or torque controlled by turning the Allen head screw which actuates an internal brake shoe. The new swivel joint may be used as a union connection.

Made of a special die cast alloy, it is available in ½-inch and ¾-inch internal pipe sizes. The joint is made to rotate 360 degrees and is intended for occasional or for intermittent turning rather than for continuous rotation. Field tests have proved that the fitting is conservatively rated at 300 psi cold working pressure for water, oil and air and for temperatures up to 225° F. The joint is of two piece construction spun together at assembly.

(This item supplements Emsco Manufacturing Company data on Pages 1465-1520 and 1521 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue.



Thermoid

POWERFLEX Rotary Hose

. . . the most widely imitated Hose in the oil field!

None have been able to fully match the strength and flexibility of Thermoid Powerflex Rotary Hose.

Powerflex is made of oil-and-abrasion-resistant synthetic rubber, reinforced with impregnated multi-ply woven fabric and high tensile steel cable. Its tough, extra-heavy cover resists weather and abrasion. The materials used in Powerflex are available to any hose manufacturer. But it's the way Thermoid wraps and couples Powerflex Hose that prevents duplication.

Patented full-flow couplings are an integral part of each cable, permanently secured before the hose is wrapped. They are guaranteed and leak-proof . . . positively cannot blow off. Every length is pre-tested to 5,000 psi . . . exceeds all API requirements.

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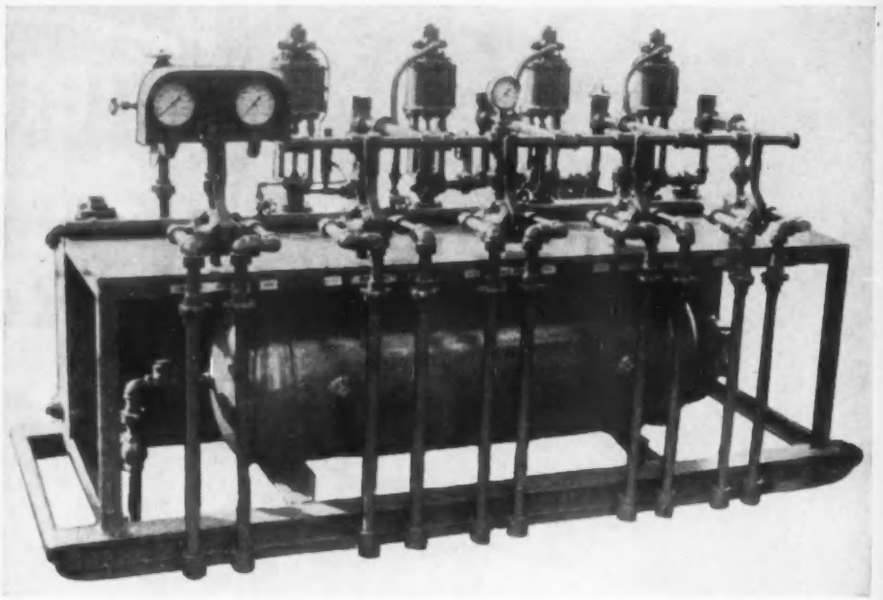
DRILLING

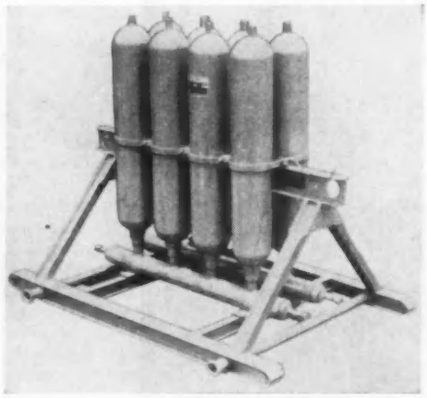


Blowout Preventer

A complete line of blowout preventer closing units designed to offer positive power protection for all types of blowout preventers is now being manufactured by the Stewart & Stevenson Distributing Company. Each unit has a minimum of two motors and two double-action pump assemblies which are interchangeable. Each motor and pump assembly is capable of closing the rams on a blowout preventer independently. A special feature of the unit permits the use of either grease or oil to operate the rams.

The unit is available in a large variety of standard models; and motors, pumps, fluid tanks, air reservoirs, compressors, explosion proof controls, fluid manifold and other accessories may be assembled into custom made units to meet specific requirements.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.



Accumulator Unit

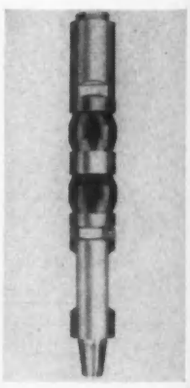
A compact new accumulator unit developed by Stewart & Stevenson Distributing Company to power blowout preventer closing units may be placed at a remote location. These power packaged accumulators furnish 3000 psi working pressure and are available in 30 to 100 gallon sizes.

The individual accumulator bottles (10 gallons each) are manifolded together into a compact package. This feature allows the system to operate even if one of the nitrogen filled bags within the bottles should fail, thus providing dependable power protection. The unit is skidmounted and may be easily serviced in the field.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

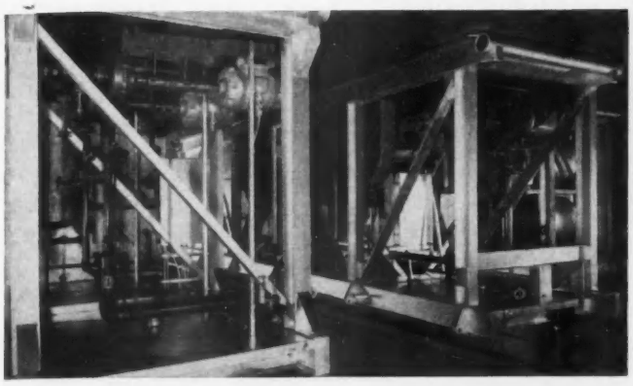
Casing Swab

A new Skinner Brothers Company casing swab does the work of 5½-inch and 7-inch OD casing by merely changing swab rubbers. The swab is made with an overload valve which permits adjustment to any load. The rubbers are made of natural rubber for longer life.



Because of its lightweight, this casing swab can be handled easily by one man, and is quickly disassembled and assembled, all parts being interchangeable. The Skinner casing swab also is available with a regular valve.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



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You save time when you turn your unitizing problem over to S&R. Being distributor for all major manufacturers of power transmission application and devices and for major equipment manufacturers of pumps, generators and engines means S&R can furnish all component parts quickly and economically. This dependable supply means job completion in minimum time.

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MAGNETROL

AS DEPENDABLE AS MAGNETIC FORCE ITSELF

● No matter how specialized the liquid level control application, adapting Magnetrol to meet it presents no problem. Whether it's for high pressures, high temperatures, corrosive liquids or any other condition, a few "standard" modifications and the job is done! Operation is so simple no changes in basic design are needed. That's why Magnetrol "fits" practically any application — why "specials" are so often standard with us.

Because of the utter simplicity and dependability of its magnetic principle, Magnetrol has *infinite operating life.* There are no wearing parts to get out of order.

Magnetrols are available for controlling level changes from .0025-in. to 150-ft., with single or multi-stage switching. Our experienced engineering staff is at your service.

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Departure from Los Angeles Oct. 1, 1956 for Melbourne, Australia — stopping in route: Honolulu, Samoa, Fiji, New Caledonia, and Sydney. Live aboard ship in Melbourne during games. On return home, stops are made at Auckland, New Zealand, Cook Island, and Tahiti. Return to Los Angeles Dec. 22. Make reservations now to assure seats at the Olympic Games — Limit 36 passengers.

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Lengths—20, 25, 30 ft.
Composite Catalog, Page 3433

Write for descriptive price list.

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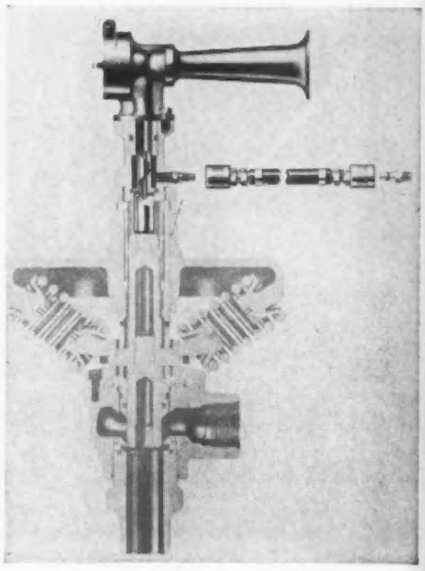
Relief Valve Signal



The new relief valve signal made by Kinzbach Tool Company, Inc. is designed to alert drilling crews for corrective measures against pressure build up.

In operation, abnormal circulating conditions build up pressure sufficiently to open relief valves. Immediate warning of relief valve action reduces time of pump operation under overload conditions by warning drilling crew. Such warning is particularly advantageous where pumps are remote from driller's station and relief valve discharge is not readily visible.

The signal consists of pilot valve actuated by movement of relief valve connected between an air supply and an air horn. At first sign of opening movement of relief valve piston, relief valve admits air to blow horn continuously until relief valve piston returns to closed position.

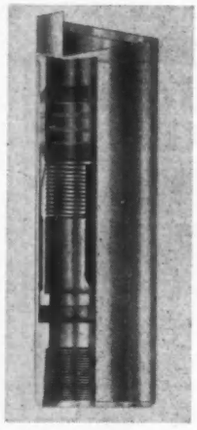
(This item supplements Kinzbach Tool Company, Inc. data on Pages 2653-2672 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

PRODUCTION

Casing Patch Process

Houston Engineers, Inc., has developed a positive and foolproof casing patch process by means of which leaks may be permanently repaired with just two trips of the working string.



The process enables the operator to locate the leak, cut off the casing below it, repair the leak with the H-E Type W Thin Wall Casing Patch, and test the job in just two round trips. Conventional methods require four or five round trips to do the same job.

The casing patch is designed to catch and pack off casings from 4½ inches to 7 inches.

(This item supplements Houston Engineers, Inc., data on Pages 2152-2172 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Fishing Tool

Houston Engineers, Inc., has developed a tool for fishing production tubing that will wash down, cut and recover the cut section in a single run. Called the H-E Hydraulic Inside Cutter, the tool can be run with guide tools or with milling or drilling bits to open a closed fish and remove obstructions within the tubing.

The new tool is used primarily in connection with sanded gas lift valves. Recovery of such valves by outside operations is impossible, because the valve itself gets in the way. The inside cutter travels within the tubing, drilling and washing as it goes, and makes its cut at a point below the obstruction. The fish having been engaged before the cut is made, an upward strain on the cutter gives positive indication of severance. The fish is then recovered on the back trip.

The cutter is made in sizes for use on 2-inch and 2½-inch, plain or E.U.E. oil well production tubing.

(This item supplements Houston Engineers, Inc., data on Pages 2153-2172 of the Composite Catalog, 20th Edition.)

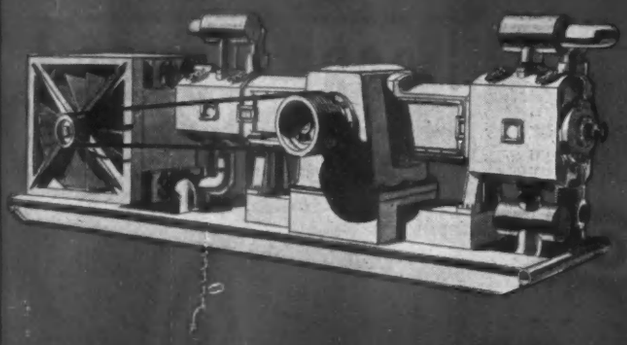
For more data, circle **No. E12** on Readers' Service Card, last page this issue.

Valve Regulator

The Permanent Valve, a new production tool manufactured by Garrett Oil Tools, Inc., provides improved operational advantages in two services. For artificial lift, it functions as a pressure-charged gas lift valve in which the operating pressure may be changed at any time without pulling tubing. As a flowing bottom hole pressure regulator, the new tool holds any desired back pressure against the sand face, and provides means of changing that back pressure through surface regulation of tubing pressure and use of wire line tools.

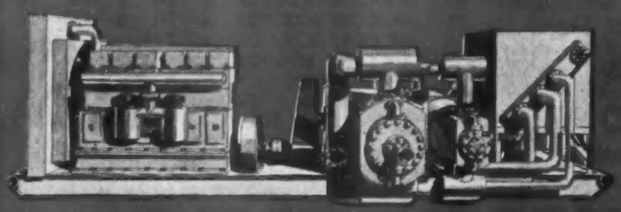
(This item supplements Garrett Oil Tools, Inc., data on Pages 1777-1780 of the Composite Catalog, 20th Edition.)

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Cooper-Bessemer Compressors

FOR AIR DRILLING



TOP: Type EM-2, rig-powered, skid-mounted, 2-cylinder air drilling compressor. Rated 200 to 300 hp at 450 rpm.

BOTTOM: Type FMP-2, independently powered, skid-mounted, 2-cylinder air drilling compressor. Rated 150 to 300 hp at 300 rpm.

Another Example of Efficient Power at Lower Cost

Today's widespread experience and experimentation in air drilling leaves no doubt about the need for true *heavy-duty* air compressor equipment. Illustrated above are two of various units developed by Cooper-Bessemer to meet this need.

Although compactly packaged and meeting all requirements for portability, these complete units offer the long life, continuous operation and extreme durability for which the larger Cooper-Bessemer compressors have long been known. And, since any one of these units will outlast a number of the high speed compressors commonly used, it is certain to live through a well completion, insure an increased rate of penetration and contribute to big reductions in drilling cost.

In addition, Cooper-Bessemer offers you a choice of packaged units to meet your particular needs perfectly. For example, as shown, there are units designed to be rig powered and others equipped with their own engines. Moreover, since these packaged units are equipped with the same standard heavy-duty cylinders used on larger Cooper-Bessemer compressors, it is possible to cover extraordinary pressure and volume ranges and employ exceptional unloading facilities.

The nearest Cooper-Bessemer office will gladly give you complete data on the ideal setup for your requirements. Get in touch with them.

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DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

New Equipment Literature

Electrolytic Control

One of the latest developments in electrolytic control is a fiberglas reinforced coupling known as "Electro-Stop," described in a new bulletin released by the Reinhold Engineering & Plastics Company. The coupling is used where two dissimilar metals, finishes or soils cause corrosion due to electrolytic action. Features, advantages and operation of the coupling are presented in the booklet accompanying drawings.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Booster Compressors

Le Roi gas booster compressors are featured in a new bulletin recently issued by Le Roi Division of Westinghouse Air Brake Company. Sectional views, component parts and the complete packaged unit, which consists of a gas-gathering compressor powered through a clutch and V-belt driven by a Le Roi engine, are illustrated. A two-page sectional view of the compressor illustrates 18 specific features of the 5, 7, 9, 11 and 13-stroke machines, ranging in size from 10 to 300-horsepower.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Perforator Brochure

Lane-Wells Company has released a brochure on their new Koneshot shaped-charge perforating development. What it is, how it works, the advantages and equipment available are included, with illustrations.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Plunger Pumps Bulletin

Featured in a new brochure issued by Worthington Corporation are the vertical triplex single acting plunger pumps with 2-inch, 4-inch, 5-inch and 6-inch strokes. The bulletin covers information on plunger pumps with capacities up to 225 GPM and pressures up to 11,700 psi. Major features are explained along with individual illustrations of component parts.

A rating chart lists the various type pumps with data on size, speed, displacement, discharge pressure, etc. Outline drawings are presented for various models along with specifications and corresponding data on general dimensions and stuffing box information.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Swivels Booklets

Ideal swivels, types N-35, N-37 and N-69, three of the six sizes in a new line offered by The National Supply Company, are presented in three new bulletins. These swivels usually are selected when drilling between 3000 and 9000 feet. Design features and specifications are given.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Pipe and Casing Protectors

A new PB Safe-Lok drill pipe and casing protectors bulletin, released by Byron Jackson Company, PB division, shows step-by-step how protectors can be installed or removed in eight to ten seconds by regular drilling crews. A clearance chart is provided, giving recommended protector sizes for various drill pipe and casing sizes. The bulletin includes specifications and price list on both the Safe-Lok casing protectors and Kelly sub protectors. Some case histories of Safe-Lok savings in the field also are presented.

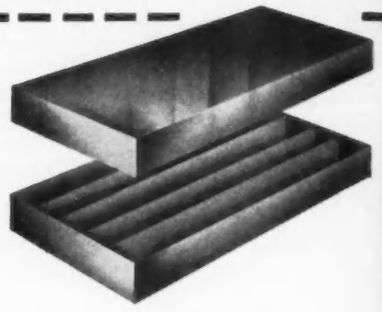
To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Lafayette Looey

An Invitation

Lafayette Looey invites you, Mr. and Mrs. Oilman, Mr. and Mrs. Supplier, Mr. and Mrs. J. Q. Citizen, to attend his debut October 13 through 16, Lafayette, Louisiana, at the Louisiana Gulf Coast Oil Exposition, an Oil Man's Oil show - - - **for the entire community.** A solid sell-out! More than 200 Exhibitors!

CORE BOXES



Each box holds 10 feet of core, and has following copy on end:
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To_____ Box No._____
"Project Name" printed on top and bottom of box.

Size	Length		Width		Depth
AX CORE BOX	24	x	8¼	x	1⅝
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EX CORE BOX	24	x	7	x	1⅛
NX CORE BOX	24	x	12	x	2¼
SPECIAL 2½" CORE BOX	24	x	13⅜	x	2⅝
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Samples available on request. Small shipments made immediately as we carry small stock of all sizes at all times. Write for catalog sheet.

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